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RESIDENTIAL COLLECTION SYSTEMS

VOLUME II. DETAILED STUDY AND ANALYSIS

ACT Systems, Incorporated

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Eleven specifically defined residential solid waste collection systems were evaluated to determine, insofar as possible, the significance of specific system parameters on productivity, efficiency, and costs. These parameters included point of collection, frequency of collection, crew size, equipment type, collection methodology, incentive system, type of storage container, and amount of waste generated. Four crews in each of the 11 systems were studied for a period of one year, using time and motion studies, backyard surveys, and a computerized Data Acquisition and Analysis Program (DAAP) for daily information. The data was collected between August 1972 and January 1974. (Shuster, EPA.)

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FOREWORD

In the spring of 1972, the Office of Solid Waste Management Programs engaged ACT Systems, Incorporated to conduct an extensive evaluation of 11 specifically defined residential collection systems. At that time, there was a dearth of good information on residential collection system productivity and costs and how various system parameters affect these items. The results of this study effort would enable the evaluation of residential collection systems and the design of more efficient and improved systems, nationwide.

The 11 systems were defined to determine, insofar as possible, the significance of specific system parameters on productivity, efficiency, and costs for residential collection. These parameters included point of collection, frequency of collection, crew size, equipment type, collection methodology, incentive system, and type of storage container. The impact of the amount of waste generated was also examined. The systems selected were designed to obtain as much interrelated information as possible from a relatively small study sample.

Four crews in each of the 11 systems were studied for a period of one year. The data gathering efforts included four quarterly time and motion studies for the curb and alley systems, four quarterly surveys for the backyard systems and daily operational information gathered each working day for each system. The daily information for each system was processed by a specially designed computerized Data Acquisition and Analysis Program (DAAP). The data was gathered between August 1972 and January 1974.

It is hoped that the information contained in this report will make a significant contribution to the understanding of residential collection system operations and to the improvement of collection system productivity. The EPA project officers on this contract were Dennis A. Schur, Donna Krabbe, and Kenneth A. Shuster.

--Arsen J. Darnay
Deputy Assistant Administrator
for Solid Waste Management

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PREFACE

The purpose of this volume is to provide a detailed analysis of the data that was obtained from the work associated with the U.S. Environmental Protection Agency Contract 68-03-0097. It is expected that this information will be used by the solid waste analysts who need to know the methodology used in arriving at the results and conclusions. The essential information which is necessary to make this volume self-contained is also provided.

Volume I contains concise summaries of the systems studied, and the significant results and conclusions that have been distilled from the contents of this volume. Single copies of Volume I are available as supplies permit from OSWMP Educational Materials Control Section, 5555 Ridge Avenue, Cincinnati, Ohio 45264.

Volume III contains the detailed information and data that was obtained during the study effort, and is not being published, although some copies are on file in OSWMP headquarters in Washington, D. C.

A brief article on this study by the project officer, Kenneth A. Shuster, has been accepted for publication by the Solid Wastes Management/Refuse Removal Journal.

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ACKNOWLEDGEMENT

This study effort would not have been possible without the willing cooperation and assistance from all the agencies and individuals that were associated with the program. In the conduct of the studies special recognition is due to the following individuals. Each of these individuals was keenly interested in the work being done and provided every possible assistance to facilitate the data gathering efforts.

Mr. E. Vern Bringhurst, Superintendent of Sanitation, Salt Lake County Highway Department, Utah

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Mr. David Opsahl, General Manager, Browning Ferris Industries of Rockford, Rockford, Illinois

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Mr. Francis Soike, Assistant Director, Sanitation Division, Operations Department, Tucson, Arizona

Mr. Joseph Maher, Chief of Sanitation, Warwick, Rhode Island

Mr. Terry Danuser, Superintendent, Streets Divsion, Oak Park, Illinois

Mr. Clarence Patterson, Superintendent, Solid Waste Division, Metropolitan Dade County, Florida

Mr. Robert Lawrence, Refuse Supervisor, San Leandro, California

Mr. Fred Larson, Commissioner of Public Works, Racine, Wisconsin.

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SECTION I

BACKGROUND INFORMATION

General

In the spring of 1972 the Office of Solid Waste Management Programs (OSWMP) engaged ACT Systems, Incorporated to conduct an extensive evaluation of 11 specifically defined residential collection systems. At that time there was a dearth of good information on residential collection system productivity and costs and how various system parameters effect these items. The results of this study effort would enable OSWMP to evaluate residential collection systems and to design more efficient and improved systems. It was expected that this effort would provide information and tools to improve the evaluation and design techniques for residential collection systems throughout the United States.

The 11 systems were defined to determine, insofar as possible, the significance of specific system parameters on productivity, efficiency and costs for residential collection. Within these 11 systems other factors, such as waste generation rates and percent of one-way storage items, were also examined to determine their significance. Data on each of the 11 systems was then gathered for a period of one year. The data gathering efforts included four quarterly time and motion studies for the curb and alley systems, four quarterly surveys for the backyard systems and daily operational information gathered each working day for each system. The daily information for each system was processed by a specially designed computerized Data Acquisition and Analysis Program (DAAP).

Definition of the 11 Collection Systems

The collection systems selected for the study were characterized by differences in type of equipment, crew size, frequency of collection, point of storage, collection methodology and incentive system. Storage containers of bags and cans were prescribed for all systems. The eleven systems are defined by specific combinations of the above variables and are indicated in Table 1. These systems were chosen to determine the relative significance of the variables listed and to assure the study results would have the broadest possible application.

Method of Selecting the Solid Waste Collection Systems

Beginning in July 1972 a concerted telephone and letter effort was made to locate candidate systems that met the requirements of the systems as defined in Table 1. After a defined system was located a personal visit was made to obtain a first-hand evaluation of the suitability of the system for study. A list of the agencies contacted is contained in Annex A of Volume III.

At least three suitable candidates were sought for each defined system. It was also desired that each candidate system have at least 10 routes. Standard information was obtained during the personal visits to the candidate systems. This information was provided to the Project Officer for his use in making the actual system selection.

For an organization to be considered as a candidate system the responsible official had to agree to keep the selected routes as stable as possible during the year of the study effort. The responsible official also had to agree to allow publication of the information determined from the study effort as it applied

TABLE 1

DEFINITION OF SELECTED COLLECTION SYSTEMS

Collection System Number	Type of Equipment	Crew Size	Frequency of Collection	Point of Storage	Collection Methodology	Incentive System	Type of Storage Container
1	Side Loader	1	1/week	Curb-Alley	1 Side of St	Task System	Bags & Cans
2	Side Loader	1	1/week	Curb-Alley	1 Side of St	8 hr day	Bags & Cans
3	Side Loader	1	2/week	Curb-Alley	1 Side of St	Task System	Bags & Cans
4	Rear Loader	2	1/week	Curb-Alley	1 Side of St	Task System	Bags & Cans
5	Rear Loader	2	1/week	Curb-Alley	1 Side of St	8 hr day	Bags & Cans
6	Rear Loader	2	2/week	Curb-Alley	1 Side of St	Task System	Bags & Cans
7	Rear Loader	3	1/week	Curb-Alley	Both Sides	Task System	Bags & Cans
8	Rear Loader	3	1/week	Curb-Alley	Both Sides	8 hr day	Bags & Cans
9	Rear Loader	3	2/week	Curb-Alley	Both Sides	Task System	Bags & Cans
10	Rear Loader	2	1/week	Backyard	Tote-barrel	Task System	Bags & Cans
11	Rear Loader	2	1/week	Backyard	Tote-barrel	8 hr day	Bags & Cans

to his system.

After a system had been designated the four routes that were serviced by the most efficient or "best" crews were selected for the detailed study. Best crews were selected to provide standards of performance by which other similar systems could be evaluated.

Definition of A Solid Waste Collection Route

For the purpose of the collection system studies a residential solid waste collection route was defined as the total activities of a collection vehicle and its crew for a period of one week. On a daily basis the activities begin with the departure of the vehicles and its crew from the motor pool in the morning and terminates with the arrival back at the motor pool at the end of the day. The route activities, therefore, encompass the specific operations of going to the area in which collections will be made, collecting the solid waste from residences, transporting the collected waste to a disposal point, and returning to the route and disposal point as required and finally returning to the motor pool. Special collections of items not normally handled by the collection vehicle such as heavy logs, tree trunks or "white goods" are excluded in this definition of a collection route. When collection activities are considered on a day of the week basis, this effort is simply a daily increment of the collection route.

Any reference in this report, therefore, to total hours worked does not include time required at the motor pool at the beginning and at the end of the day to check in and out, to check and clean equipment or to conduct other authorized matters. All references to crew sizes include the drivers and collectors.

General Method of Evaluating Solid Waste Collection Systems

The actual evaluation of the systems was done by using two independent approaches. One approach was based on information obtained from the collection routes on a daily basis and processed by the computerized DAAP. The other approach was based on data obtained from the time motion studies or backyard surveys which were conducted on a quarterly basis. A summary DAAP report for the 12 months of study and information extracted from the time motion reports and backyard surveys are contained in this volume. The systems analysis was based on these data. The monthly DAAP reports and additional time motion data are provided in Volume III.

The DAAP information gathering activities and time motion studies or backyard surveys were implemented during the first visit to the system after its selection. The initial effort required two weeks, during which study requirements were coordinated, the DAAP background information was obtained, extensive descriptive data were obtained for each system and the initial time and motion study or backyard survey was conducted. A complete descriptive report of each system was provided separately to the Project Officer. Pertinent information was extracted from these descriptive reports to make this final report complete, and is contained in each of the three volumes of the report.

Pictorial Requirements

In conjunction with the time and motion studies and quarterly visits to the locations of the 11 systems motion pictures were taken to show the collection methodology and general condition of the routes. Two rolls of 8 mm movie film were exposed on each route during each visit. This was used to provide the Project Officer with an edited film of approximately 15-18 minutes duration on each of the 11 systems studied.

Brief System Descriptions

General. The system descriptions provided in this volume have been extracted from the system descriptions of Annex B of Volume III. The information provided in this section was limited to that which was essential for an understanding of the data presented.

System I, Salt Lake County, Utah. The Salt Lake County Sanitation Division used both 25 cubic yard side loading collection vehicles and 20 cubic yard rear loading collection vehicles for the residential collections. Commercial waste was not collected by the Sanitation Division. All commercial waste was collected by private operators. The Sanitation Division did not collect bulky construction or bulky garden wastes.

The average age of the collection vehicles, at the time of the study, was three years. The expected life of the vehicles was five years. The newer side loading vehicles were powered with diesel engines. All other vehicles were powered with gasoline engines.

The rear loading vehicles were used primarily in the rural and mountainous areas while the side loading vehicles were used in the more densely populated areas. Only the four best routes using the side loading equipment were used in this study.

Each of the four routes studied met all of the requirements for System I, as defined. The crews worked on a task incentive system and averaged almost 30 hours per week working compared with a planned work week of 40 hours. An average of 410 homes was serviced per day per crew with the average weight per home per collection being 46.2 pounds. Each crew averaged 1.8 loads per day. The average weight collected per crew per day was 9.4

tons. The storage containers consisted of 34 percent bags 52 percent cans and 14 percent miscellaneous items.

System 2, Covina, California. The Covina Street and Refuse Division used both 25 cubic yard side loading collection vehicles and 30 cubic yard front loading collection vehicles. The side loading vehicles were used for the residential collections and the front loading vehicles were used for the commercial collections. One of the side loading routes also collected from commercial accounts, but this route was not part of this study.

The average age of the side loading vehicles, at the time of the study, was three years. The expected life of the vehicles was five years. All refuse collection vehicles were leased from the Covina Equipment Division. The daily rate for the side loading vehicles was $75.00. This cost included all maintenance, depreciation and consumables.

Each of the four routes studied met all of the requirements for System 2, as defined. The crews worked on a standard eight-hour day incentive system and averaged almost 34 hours per week working on collection related activities compared with a planned work week of 40 hours. An average of 254 homes was serviced per day per crew with the average weight per home per collection being 71.0 pounds. Each crew averaged 1.6 loads per day. The average weight collected per crew per day was 9.0 tons. The storage containers consisted of 26 percent bags, 53 percent cans and 21 percent miscellaneous items.

System 3, Phoenix, Arizona. The Phoenix Sanitation Division used both 33 cubic yard side loading collection vehicles and 20 cubic yard rear loading collection vehicles for its residential collection routes. There was some mixing of light commercial waste with residential waste on all residential routes. Large commercial accounts were serviced by City front loading vehicles and by private collectors.

The average age of the side loading vehicles, at the time of the study, was less than one year. The expected life of the vehicles was five years. The Sanitation Division pays the Maintenance Division a fee of $0.50 per mile for the side loading vehicles for insurance, consumables, license fees and maintenance.

Each of the four routes studied met all of the requirements for System 3, as defined. The crews worked on a task incentive system and averaged almost 32 hours per week working compared with a planned work week of 40 hours. The City of Phoenix collected on a frequency of twice a week. The collection days were Monday-Thursday, Tuesday-Friday and Wednesday-Saturday. A personnel rotating system was used so that the planned work week for the crews was only 40 hours. Considering the six days of collection, each route averaged slightly more than 38 hours per week compared with a planned period of 48 hours. An average of 410 homes was serviced per day per crew with the average weight per home per collection being 28.2 pounds. Each crew averaged 1.0 loads per day. The average weight collected per crew per day was 5.7 tons. The storage containers consisted of 29 percent bags, 53 percent cans and 18 percent miscellaneous items.

System 4, Rockford, Illinois. The residential collections in the City of Rockford were performed by a private company of Rockford under contract to the City of Rockford. The company used 20 cubic yard rear loading collection vehicles. There was no mixing of residential and commercial waste.

The average age of the collection vehicles, at the time of the study, was one year. The expected life of the vehicles was seven years. All of the vehicles were powered with gasoline engines. All maintenance was performed in maintenance facilities of the company.

For this study effort, only operational data were provided. By agreement between the OSWMP and the Corporate Office of the operating company financial information pertaining to the collection activities would not be provided. No financial information was obtained during the study effort.

Each of the four routes studied met all of the requirements for System 4, as defined. The crews worked on a task incentive system and averaged almost 36 hours per week working compared with a planned work week of 40 hours. An average of 512 homes was serviced per day per crew, with the average weight per home per collection being 49.3 pounds. Each crew averaged 2.4 loads per day. The average weight collected per crew per day was 12.6 tons. The storage containers consisted of 56 percent bags, 28 percent cans and 16 percent miscellaneous items.

System 5, Flint, Michigan. The Flint Waste Collection and Disposal Division used both 25 cubic yard and 20 cubic yard rear loading collection vehicles for its residential collection routes. There was no mixing of residential and commercial waste.

The average age of the collection vehicles, at the time of the study, was three years. The expected life of the vehicles was five years. Most of the vehicles were powered with diesel engines. All maintenance was performed at the municipal garage.

Each of the four routes studied met all the requirements for System 5, as defined. There was no distinction between the driver and collector, and they alternated between driving and collecting. The crews worked on a standard eight-hour day incentive system and averaged slightly more than 35 hours per week on collection related activities, compared with a planned work week of 40 hours. An average of 575 homes was serviced per day per crew with the average weight per home per collection being 50.5 pounds. Each crew averaged 1.9 loads per day. The average weight collected per crew per day was 14.5 tons. The storage containers consisted of 85 percent bags, 6 percent cans, and 9 percent miscellaneous items.

System 6, Tucson, Arizona. The Tucson Sanitation Division used side loading collection vehicles with detachable eight cubic yard containers and the container-train system for its residential collections. Each of these systems was supported by front loading mother trucks of 32 cubic yards capacity. At the time of the study, the City was in the process of converting its train system to the detachable container system. There was some mixing of light commercial waste with the residential waste on all of the residential routes.

The average age of the detachable container units, at the time of the study, was one year. The average age of the mother trucks was two and one-half years. The expected life of the detachable container trucks was seven years, and the expected life of the mother trucks was five years. All vehicles were powered with gasoline engines.

The four routes studied consisted of one complete detachable container task force in the City of Tucson. These four routes operated in a specifically designated geographical area, and were supported by a mother truck. The system met all of the requirements for System 6 except the type of vehicle. The specified vehicle for System 6 was a rear loader. No satisfactory System 6 could be found during the survey of systems. The Tucson system was, therefore, used as a substitute system.

For the purposes of this study, all of the waste from the four routes was kept separate from other wastes and was weighed separately.

This was not the normal procedure in the City.

The crew consisted of two men with no distinction between the driver and collector. Both crewmen drove and collected. The crews worked on a task incentive system and averaged slightly more than 23 hours per week compared with a planned work week of 32 hours on residential collections. The frequency of collection in Tucson was twice a week. The collection days were Monday-Thursday and Tuesday-Friday. Wednesday was used for special non-residential collections or for maintenance operations.

An average of 574 homes was serviced per day per crew with the average weight per home per collection being 24.4 pounds. Two of the four routes had a large percentage of mobile homes on them. Each crew averaged 4.4 loads per day. The average weight collected per crew per day was 7.0 tons. The storage containers consisted of 19 percent bags, 61 percent cans, and 20 percent miscellaneous items.

Subsequent to the completion of the study, the sanitation administrator reported that changes were made to add approximately 200 homes per day to the routes. With this change, the crews averaged approximately 28 hours per week, compared with a planned 32 hours.

System 7, Warwick, Rhode Island. The Warwick Sanitation Division used both 20 cubic yard and 16 cubic yard rear loading collection vehicles for its residential collection routes. There was no mixing of residential and commercial waste. All commercial waste was collected by private operators.

The average age of the collection vehicles, at the time of the study, was one year. The expected life of the vehicles was five years. All of the rear loaders were powered with diesel engines. All maintenance was performed by the Automotive Division.

Each of the four routes studied met all the requirements for System 7, as defined. The crew worked on a task incentive system and averaged 26 hours per week working compared with a planned work week of 40 hours. An average of 407 homes was serviced per day per crew with the average weight per home per collection being 62.2 pounds. One route had a high percentage of estate type residences on it with greater distances between stops than the typical suburban areas. Each crew averaged 2.2 loads per day. The average weight collected per crew per day was 12.7 tons. The storage containers consisted of 56 percent bags 28 percent cans and 16 percent miscellaneous items.

System 8, Oak Park, Illinois. The Oak Park Solid Waste Collection Section used rear loading collection vehicles with capacities of 25, 20, 18 and 17 cubic yards. There was no mixing of residential and commercial waste. All commercial waste was collected by private operators.

The average age of the collection vehicles, at the time of the study, was four years. The expected life of the vehicles was six to seven years. All of the collection vehicles were powered with gasoline engines. All maintenance was performed by the Maintenance Division.

Each of the four routes studied met all the requirements for System 8, as defined. Approximately 98 percent of the refuse was collected from alleys. The crews worked on a standard eight-hour day incentive system and averaged slightly more than 39 hours per week on collection related activities compared with a planned work week of 40 hours. Crews collected along the route as far as possible within the normal eight-hour day then continued from the stopping place on the following day. An average of 306 homes was serviced per day per crew with the average weight per home per collection being 64.9 pounds. Each crew averaged 1.6 loads per day. The average weight collected per crew per day was 9.7 tons. The storage containers consisted of 25 percent bags, 47 percent cans and 28 percent miscellaneous items.

System 9, Metropolitan Dade County, Florida. The Metro-Dade County Waste Division used both 25 cubic yard and 20 cubic yard rear loading collection vehicles for its residential collection routes. There was some mixing of light commercial waste with the residential waste on all of the routes.

The average age of the collection vehicles, at the time of the study, was four years. The expected life of the vehicles was seven years. Most of the vehicles were powered with gasoline engines; however, all of the newer vehicles were powered by diesel engines. All maintenance was performed in the County maintenance shops.

Each of the four routes studied met all the requirements for System 9, as defined. The crews worked on a task incentive system and averaged slightly more than 25 hours per week working compared with a planned work week of 40 hours. Metro-Dade County collects on a frequency of twice a week. The collection days were Monday-Thursday and Tuesday-Friday. No collections were made on Wednesday. The normal collection day was considerad to be 10 hours. An average of 854 homes was serviced per day per crew with the average weight per home per collection being 33.1 pounds. Each crew averaged 2.3 loads per day. The average weight collected per crew per day was 14.1 tons. The storage containers consisted of 46 percent bags, 41 percent cans and 13 percent miscellaneous items.

System 10, San Leandro, California. The City of San Leandro used 20 cubic yard rear loading collection vehicles for its residential collection routes. There was some mixing of light commercial waste with the residential waste on all of the routes.

The average age of the collection vehicles, at the time of the study, was two years. The expected life of the vehicles was seven years. Approximately one-half of the vehicles were powered with gasoline engines. The other half of the vehicles were powered by diesel engines. All maintenance was performed by the City Maintenance Division.

Each of the four routes studied met all the requirements for System 10, as defined. This was a backyard system. The crew size was two men. There was no distinction between the driver and collector, and they alternated the driving. The crews worked on a task incentive system and averaged slightly more than 31 hours per week working compared with a planned work week of 40 hours. An average of 364 homes was serviced per day per crew with the average weight per home per collection being 33.9 pounds. Each crew averaged one load per day. The average weight collected per crew per day was 6.2 tons. The storage containers consisted of 2 percent bags, 96 percent cans and 2 percent miscellaneous items.

System 11, Racine, Wisconsin. The Racine Solid Waste Collection Division used rear loading collection vehicles with capacities of 20, 16 and 13 cubic yards for its residential collection routes. There was some mixing of light commercial waste with the residential waste on all of the routes.

The average age of the collection vehicles, at the time of the study, was eight years. The expected life of the vehicles was 10 years. The newer 20 cubic yard vehicles were powered with diesel engines. The other vehicles were powered with gasoline engines. All maintenance was performed by the Equipment Maintenance Division.

Each of the four routes studied met all the requirements for System II. While this was considered a backyard system, approximately one-third of the collections were made from the curb or alleys. The crew size was two men. There was no distinction between the driver and collector, and they alternated the driving. The crews worked on a standard eight-hour incentive system and averaged almost 35 hours per week on collection related activities compared with a planned work week of 40 hours. An average of 243 homes was serviced per day per crew with the average weight per home per collection being 51.1 pounds. Each crew averaged 1.9 loads per day. The average weight collected per crew per day was 6.2 tons. The storage containers consisted of 33 percent bags, 55 percent cans and 12 percent miscellaneous items.

How Representative Are The Systems Chosen

There is great variability in the conduct of residential collection operations across the country. This variability takes many forms. There may be public and private collection operations. Within each of these sectors there may be union or non-union organizations. Within the collecting organization there may be differences in the operating parameters such as the kind of collection equipment that is used, the size of the crew, the frequency of collection, the residential storage point, the collection methodology, the incentive system and the kind of storage containers that are used. There are additional factors that have an impact on the collection operation. These may include the climate of the geographical area, the affluence of the area, the amount and type of waste generated, the housing densities, the types of structures (single or multi-family), the distance to the disposal site and any queuing that might exist at the disposal site, the local ordinances or rules and regulations and the personnel administration policies and pay scales. This is not an all inclusive list but does indicate most of the factors that can influence a residential collection operation.

In conceiving this study the OSWMP desired to obtain reliable information on those facets of a collection operation that appeared to have the greatest impact on the productivity and efficiency of various systems. In addition, it was desired to obtain quantified measures of productivity and efficiency from the best operating systems that could be reasonably found. The maximum amount of information was desired from what was considered to be a reasonable sample size. Accordingly, the system definitions of Table 1 evolved.

The definitions of Table 1 provide varied combinations of type of equipment, crew size, collection frequency, point of storage, collection methodology and incentive system. Bags and cans were prescribed as the storage container for all systems.

At the time the systems were defined it was not known whether all of the systems existed in practice. However, it was believed that there was a good probability that the systems could be found; and if they could be found, the matrix of factors would permit an evaluation of the significance of those factors.

A concerted effort was made to locate the systems, as defined. To obtain the initial information regarding candidate systems the following agencies were contacted: the solid waste management representative of all EPA regions, the solid waste management agencies of the 48 states, the American Public Works Association, the National Solid Waste Management Association and the major collection vehicle manufacturers. In addition, phone calls were made directly to cities and counties to obtain desired information concerning their residential collection systems. The agencies that responded to this effort are listed in Annex A of Volume III. All recommended systems were contacted by telephone. In addition, a separate telephone survey was conducted to locate suitable systems. Information was received from 299 organizations and 69 organizations were actually visited to make a first-hand evaluation of the system.

For the purposes of the study it was desired to study the most productive and most efficient systems that could be found and that met the prescribed definitions. It was hoped that the "best" systems would also provide a reasonable geographical distribution to make the results more generally applicable.

The results of the systems search provided a reasonable number of candidate systems except for Systems 2, 6 and 11. The system that was finally chosen for study was considered to be the most productive and efficient of the systems that were known at the time of selection.

Only one candidate for System 2 was discovered and that was in Covina, California. This system was selected for study.

No suitable candidates for the defined System 6 were discovered during the systems search; therefore, a substitute system was used that met all the requirements except for the type of equipment. The system finally selected was in the City of Tucson, Arizona. This city used side loading collection vehicles with detachable eight cubic yard containers. All other system parameters met those prescribed for System 6.

Only one suitable candidate was discovered for System 11, and that was in Racine, Wisconsin. This system was selected for study.

At the time the specific systems were selected for study the best system was chosen. No further consideration was given to other systems that met the defined parameters after a specific system was selected. There may be other systems in the country that are more productive or more efficient than the systems that were finally selected for study. They were unknown at the time of the system selection and are unknown at this time. The possibility that there is somewhere a system which is marginally more productive than the systems used in the study does not invalidate the study results or conclusions in any way. The results of the study, as presented in this final report, provide reasonable productivity and efficiency goals for comparison purposes. These results will also provide solid waste managers with a valid estimate of what can be expected if a change in system operation is contemplated.

SECTION II

PRESENTATION OF STUDY DATA

Data Acquisition

As already mentioned, two kinds of data were obtained during the study effort. The daily collection route information was obtained from each route of each system for each day of operation during the study period. Data were recorded on the form of Figure 1. This information was processed on a monthly basis. by the DAAP computer program. In addition, all of the data for each route and for each system were processed to provide a summary report for the entire year of the system studies. A description of the DAAP reports is provided in Appendix 1. The monthly reports are provided in Annex C of Volume III. The yearly summary report is provided as Appendix 2. The yearly DAAP summary report provides the basis for the analysis made in this report.

The time motion or backyard survey data were obtained on a quarterly basis. Once each quarter each curb or alley system was visited and a time motion team spent one entire day with each route that was being studied. Data were recorded on the forms of Figures 2 and 3. These data were processed by a specially designed computer program to generate time motion reports. The fourth quarter and summary time motion reports for each system are provided by Appendix 3. Detailed information pertaining to the conduct of the time motion studies is provided by Annex D of Volume III.

During the quarterly visits to the backyard systems a backyard survey was made. Again, one entire day was spent with each

FIGURE 1

DAILY COLLECTION ROUTE INFORMATION

ROUTE______________ DATE______________ DAY______________ CREW SIZE______________

VEHICLE NO.________ SIZE(CU.YD.)______ FUEL(GAL)________ ENG.OIL(QT)____________

NO. HOMES SERVED____________	TIME	MILES	WEIGHT	DISCHARGE POINT *
LEAVE MOTOR POOL				▨
START COLLECTION			▨	▨
LEAVE ROUTE			▨	▨
AT DISCHARGE POINT	▨	▨		
ARRIVE BACK ON ROUTE			▨	▨
LEAVE ROUTE			▨	▨
AT DISCHARGE POINT	▨	▨		
ARRIVE BACK ON ROUTE			▨	▨
LEAVE ROUTE			▨	▨
AT DISCHARGE POINT	▨	▨		
ARRIVE BACK ON ROUTE			▨	▨
LEAVE ROUTE			▨	▨
AT DISCHARGE POINT	▨	▨		
ARRIVE BACK ON ROUTE			▨	▨
LEAVE ROUTE			▨	▨
AT DISCHARGE POINT	▨	▨		
ARRIVE AT MOTOR POOL			▨	▨

LUNCH - START - FINISH			BREAKDOWN - PROBLEM (Circle Number)
BREAKDOWN - START - FINISH			1 Brakes, wheels, tires 2 Cooling or exhaust sys 3 Electrical sys 4 Fuel sys 5 Packer 6 Power or steering sys 7 Other

* ENTER NUMBER
1=INCINERATOR
2=LANDFILL
3=TRANSFER STATION

REMARKS:

DATA VERIFIED BY:____________________

FIGURE 2

CURB COLLECTION CONTROL SHEET

END ODOMETER ______________ TOTAL DISTANCE ______________ NO. ________

BEGIN ODOMETER ______________ DATE ______________

SERVICES	DWELLING UNITS	ITEMS				TRUCK PATH	COMMENTS
		C	S	B	M		R NR T
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							Total Times
36							Driving=
37							
38							Waiting=
39							
							Collect.=
TOTAL							
AVERAGES						Rt. Dist	Other=
		R=		NR=			

FIGURE 3

COLLECTOR ACTIVITY RECORD

COLLECTOR: ____________ TOTAL ELAPSED TIME: ____________ NO.: ________

DATE: ____________ OTHER TIME: ____________

DATA BY: ____________ ROUTE DISTANCE: ____________

SERVICES	SIDE OF STREET	ITEMS				TIMES				COMMENTS
		C	S	B	M	RIDING	WALKING	WAITING	COMPACTION	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
TOTALS:										Other Time
AVERAGES										

R= NR=

route of the system. This backyard survey consisted of measuring the perpendicular distance from the curb to the storage point and the number of containers by type for each service surveyed. These data were recorded on the form of Figure 4. The data were processed manually to provide a comparison between the DAAP data and data derived by applying the survey results to a regression equation that was provided by OSWMP. Detailed information pertaining to the conduct of the backyard survey is provided by Annex D of Volume III. Summary backyard survey reports are provided by Appendix 3.

DAAP Standard Data

The DAAP computer program was designed to facilitate the analysis of the daily collection route data that were obtained from the study effort. In order to eliminate the local cost differences that existed among the various systems being studied, standard costs were used. Costs for services being performed would then be primarily a function of the operation performance. Insofar as possible, the standard costs that were used were the average costs for all of the systems and were as follows:

Initial Cost of Vehicles

Capacity (cu yds)	Side Loader	Rear Loader
13		$15,900
16		$16,700
18		$17,000
20		$22,700
25	$23,900	$23,900
33	$30,000	
Detachable Container Vehicle plus 1/4 cost of Mother truck.	$28,100	

FIGURE 4

STORAGE LOCATION SURVEY FORM

SERVICES	DWELLING UNITS	DISTANCE	ITEMS	COMMENTS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				

Depreciation

The depreciation period is five years.

Maintenance Cost Per Year

Maintenance cost (first year) = .055 X initial cost of vehicle.

Consumable Costs

Fuel $0.17 per gallon. Engine oil $0.23 per quart.

Insurance and Fees

The yearly cost of insurance and fees is $1,200 per vehicle. The effective cost of insurance for one detachable container route (including mother truck) is $1,500 per year.

Salaries (dollars per hour)

Driver $4.34. Collectors $4.15. The effective cost of the detachable container crew (including mother truck driver) is $4.93 and $4.73 for the driver and collector respectively.

Fringe Benefits

Fringe benefits are 18.3 percent of salary.

Personnel Overhead

Personnel overhead is 13.1 percent of salary.

Overtime Factor

Overtime factor of 1.5 for drivers and collectors.

The daily cost of depreciation, maintenance and insurance and fees is a function of the number of normal work days for each of the systems. The number of normal work days that was used in the program for each of the systems is listed below:

System	Number of Work Days
1	260
2	255
3	310
4	261

System	Number of Work Days
5	261
6	208
7	260
8	252
9	207
10	255
11	260

In determining the cost of equipment the 1972 replacement cost was used as the standard. Where 1972 equipment was being used in conjunction with the system studies this cost was used. No problems were encountered with the costs of the side loading equipment. There was a considerable range of costs associated with the rear loading equipment depending on whether the equipment was designed for medium or heavy duty packing and depending on the chassis and packer make. Average costs were determined for medium duty packing equipment, and these were used.

There was a wide variation in the maintenance costs reported by the participating agencies. Looking at the reported maintenance costs for the first yearly increment of equipment use and comparing these with the reported purchase price indicated a maintenance cost of between five and eight percent. The yearly maintenance costs were averaged and converted to a percent. The value of five and one-half percent was used.

The average of the reported fuel and engine oil unit costs, salaries, fringe benefits and personnel overhead rates was used. Personnel overhead included all supervisory personnel and other support personnel that were directly related to the collection operation.

Presentation of Selected Items from the DAAP and Time Motion Reports

To simplify the presentation and understanding of the study data, items of key interest and importance have been extracted from the DAAP and time motion reports. These items are provided in tables and graphs in this section. In each case, system averages are provided for the period.

In Tables 2 through 12, selected performance data are provided by system on a monthly basis. These data include tons collected per day, homes served per day, collection miles per day, number of one-way items per home, number of two-way items per home, collection hours per day, transport hours per day, loads per day, pounds per home per collection, minutes per home per collection, homes served per collection hour, collection cost per home per week, total cost per home per week and the cost per ton. Table 13 provides the yearly averages for the same items by system.

The seasonal solid waste generation rates for each system, in terms of pounds per home per week, are presented in Table 14. The seasonal tons collected per crew per day for each system are presented in Table 15.

Graphs of the information of Tables 14 and 15 are shown in Figures 5 through 15. Each graph contains two sets of data using two different scales. One scale is in tons per crew per day. The other scale is in pounds per home per week.

Figures 16 through 18 show the average number of homes served per week, the average weight per home per week, and the average total weight collected per day by system in bar graphs.

TABLE 2
SELECTED DATA

SYSTEM NUMBER 1, SALT LAKE COUNTY, UTAH

1 man crew
25 cubic yard side loaders

One collection per week at curb/alley,
collect one side of the street
Task incentive

Month	Tons/Day	Homes/Day	Coll.Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr.	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	7.35	407	12.0	46	54	3.94	1.43	1.6	36.3	.59	104.6	.13	.19	10.66
F	7.49	405	9.7	46	54	3.29	1.30	1.5	37.0	.49	123.7	.13	.19	10.51
M	8.99	417	10.0	47	53	3.41	1.57	1.7	43.2	.50	122.9	.12	.18	8.73
A	9.43	407	9.4	47	53	3.55	1.69	1.8	46.5	.53	116.0	.12	.19	8.32
M	11.33	409	10.8	47	53	4.44	1.96	2.0	55.7	.66	92.1	.13	.19	6.94
J	10.76	414	10.6	54	46	3.83	2.00	1.9	52.3	.56	108.6	.12	.18	7.28
J	10.73	412	9.3	54	46	3.34	1.86	1.9	52.3	.49	124.3	.11	.18	7.27
A	11.30	411	8.9	54	46	3.81	2.00	2.0	55.2	.56	108.6	.12	.18	6.85
S	9.78	413	10.5	46	54	4.04	1.94	1.9	47.6	.59	102.1	.12	.18	8.03
O	8.93	407	10.9	46	54	3.99	1.62	1.8	44.1	.59	101.7	.13	.19	8.79
N	9.25	414	11.5	46	54	4.03	1.59	1.7	44.9	.59	102.7	.13	.18	8.48
D	7.88	408	12.3	46	54	4.24	1.58	1.5	38.8	.63	97.5	.13	.19	9.96
Avg.	9.44	410	10.5	48	52	3.83	1.71	1.8	46.2	.56	107.3	.13	.19	8.29

* From Time Motion Studies

TABLE 3
SELECTED DATA

SYSTEM NUMBER 2, COVINA, CALIFORNIA

1 man crew
25 cubic yard side loaders

One collection per week at curb/alley,
one side of the street
8 hour day

Month	Tons/Day	Homes/Day	Coll.Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	7.87	249	6.5	41	59	4.21	1.75	1.5	63.2	1.01	59.7	.21	.30	9.74
F	8.98	246	6.8	41	59	4.06	1.82	1.5	73.0	.99	60.7	.21	.30	8.52
M	9.25	248	5.9	46	54	4.05	1.88	1.5	74.7	.98	61.2	.20	.30	8.24
A	9.41	244	5.5	46	54	4.75	2.18	1.7	77.2	1.17	51.4	.21	.31	8.14
M	10.07	249	6.2	46	54	4.89	2.04	1.8	80.9	1.18	50.9	.21	.30	7.59
J	9.51	244	5.3	48	52	4.81	2.18	1.8	78.0	1.18	50.8	.21	.31	8.03
J	10.32	259	6.1	48	52	4.78	2.15	1.8	80.2	1.12	54.3	.20	.29	7.40
A	9.93	320	5.2	48	52	4.69	2.26	1.7	66.1	.93	68.2	.17	.25	7.74
S	8.50	245	5.8	53	47	4.74	1.90	1.6	69.4	1.16	52.0	.21	.30	8.77
O	8.38	251	6.3	53	47	4.74	2.05	1.6	66.9	1.13	53.1	.21	.30	9.16
N	8.40	247	7.6	53	47	4.31	1.95	1.5	68.0	1.05	57.3	.21	.30	9.11
D	8.06	253	6.0	41	59	4.70	2.09	1.6	63.8	1.12	53.9	.21	.30	9.54
Avg.	9.00	254	6.1	47	53	4.56	2.01	1.6	71.0	1.08	55.7	.20	.30	8.46

*From Time Motion Studies

TABLE 4
SELECTED DATA

SYSTEM NUMBER 3, PHOENIX, ARIZONA

1 man crew
33 cubic yard side loaders

Two collections per week at curb/alley,
one side of the street
Task incentive

Month	Tons/Day	Homes/Day	Coll.Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	4.99	395	10.7	55	45	4.35	1.15	1.0	25.3	.66	91.2	0.28	15.56	0.39
F	5.33	390	12.1	55	45	4.51	1.06	1.0	27.4	.70	86.7	0.30	14.87	0.40
M	6.34	404	13.7	43	57	4.73	1.04	1.0	31.6	.71	85.5	0.30	12.22	0.38
A	6.72	414	13.7	43	57	5.32	.92	1.0	32.7	.78	78.0	0.30	11.47	0.37
M	6.43	415	13.4	43	57	5.36	1.09	1.0	31.4	.78	77.4	0.30	12.05	0.37
J	5.91	417	15.4	42	58	5.25	1.09	1.0	28.7	.76	79.4	0.30	12.94	0.36
J	6.41	422	15.8	42	58	5.45	1.09	1.0	30.7	.78	78.1	0.30	12.05	0.36
A	5.75	415	14.5	42	58	5.02	1.10	1.0	28.0	.73	82.9	0.28	13.36	0.37
S	5.33	415	15.0	46	54	4.64	1.08	1.0	25.9	.68	90.2	0.28	14.53	0.37
O	5.15	414	12.6	46	54	4.78	1.07	1.0	25.0	.70	86.8	0.28	15.00	0.37
N	5.09	410	13.6	46	54	4.46	1.04	1.0	25.0	.66	92.2	0.28	15.35	0.37
D	5.11	410	14.5	55	45	4.58	1.13	1.1	25.1	.68	89.4	0.28	15.10	0.37
Avg.	5.73	410	13.7	47	53	4.88	1.07	1.0	28.2	.72	84.2	0.30	13.48	0.37

* From Time Motion Studies

TABLE 5
SELECTED DATA

SYSTEM NUMBER 4, ROCKFORD, ILLINOIS

2 man crew
20 cubic yard rear loader

One collection per week, curb and alley,
one side of the street
Task incentive

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	9.72	501	10.1	72	28	4.41	1.27	2.2	38.8	.53	114.6	.18	.23	12.31
F	9.09	504	9.6	72	28	3.79	1.30	2.0	36.1	.45	135.2	.17	.23	13.14
M	11.42	507	9.1	72	28	3.78	1.88	2.3	45.1	.45	135.6	.15	.23	10.49
A	13.92	516	11.0	72	28	5.11	2.25	2.5	54.0	.59	102.2	.15	.23	8.70
M	16.25	525	11.9	72	28	5.50	2.28	2.6	61.9	.63	96.1	.16	.22	7.45
J	15.99	522	11.7	70	30	5.18	2.36	2.5	61.3	.60	101.6	.15	.23	7.62
J								NO DATA						
A								NO DATA						
S	13.50	517	8.8	72	28	4.89	2.08	2.2	52.2	.57	106.3	.16	.23	8.93
O	13.60	510	8.9	72	28	5.43	2.09	2.4	53.3	.64	94.1	.16	.23	8.87
N	13.02	518	9.8	72	28	5.27	2.22	2.5	50.3	.61	98.9	.16	.23	9.32
D	9.55	504	9.5	72	28	4.63	1.45	2.2	37.9	.55	109.6	.17	.23	12.51
Avg.	12.62	512	10.1	72	28	4.82	1.92	2.4	49.3	.56	107.0	.16	.23	9.53

* From Time Motion Studies

TABLE 6
SELECTED DATA

SYSTEM NUMBER 5, FLINT, MICHIGAN

2 man crew
25 cubic yard rear loader

One collection per week, curb and alley,
one side of the street
8 hour day

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	13.15	566	12.5	92	8	4.36	1.53	1.8	46.5	.46	129.9	.16	.22	9.76
F	12.47	560	12.9	93	7	4.33	1.85	1.9	44.4	.46	131.0	.16	.23	10.67
M	16.15	609	15.2	93	7	5.50	1.83	2.0	52.9	.54	112.0	.16	.22	8.62
A	15.55	564	14.0	93	7	4.76	1.63	1.9	55.4	.51	118.5	.16	.21	7.96
M	NO DATA													
J	17.41	576	14.1	94	6	5.22	1.87	2.0	60.6	.54	110.5	.15	.21	7.06
J	12.69	539	11.2	94	6	4.40	2.08	1.9	47.1	.49	122.7	.15	.22	9.62
A	15.27	676	10.8	95	5	4.08	1.73	2.0	48.5	.39	165.9	.13	.19	8.07
S	NO DATA													
O	15.03	539	13.6	95	5	4.59	1.78	2.1	55.8	.51	119.2	.16	.22	8.31
N	15.27	579	13.5	92	8	4.71	1.74	2.1	52.6	.49	123.0	.15	.21	8.28
D	13.23	568	13.3	92	8	4.97	1.60	1.8	46.6	.53	114.7	.17	.22	9.77
Avg.	14.49	575	13.1	94	6	4.67	1.75	1.9	50.5	.49	123.3	.15	.22	8.72

*From Time Motion Studies

TABLE 7
SELECTED DATA

SYSTEM NUMBER 6, TUCSON, ARIZONA

2 man crew
8 cubic yard detachable containers

Two collections per week, curb and alley,
one side of the street
Task incentive

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	6.25	571	19.5	39	61	3.99	1.35	4.1	21.7	.43	143.0	.19	.51	23.67
F	7.06	575	20.6	39	61	4.23	1.26	4.4	24.7	.44	135.7	.20	.52	21.42
M	6.62	574	20.8	39	61	3.92	1.27	4.0	23.2	.41	146.7	.19	.52	22.63
A	7.25	576	20.9	40	60	4.26	1.31	4.5	25.2	.45	135.2	.19	.50	20.12
M	6.83	574	19.5	40	60	3.99	1.23	4.5	24.1	.42	144.0	.19	.50	21.32
J	6.90	569	21.3	40	60	4.27	1.34	4.7	24.4	.45	134.0	.19	.52	21.50
J	7.91	573	22.8	40	60	4.23	1.40	4.7	27.7	.44	135.5	.19	.50	18.38
A	6.96	578	20.1	40	60	4.17	1.71	4.3	24.1	.44	140.0	.18	.52	22.38
S	7.09	578	21.0	40	60	4.44	1.57	4.4	24.6	.46	130.4	.19	.51	20.99
O	6.53	565	19.5	37	63	4.29	1.59	4.2	23.2	.46	132.5	.18	.51	22.53
N	6.55	572	19.8	37	63	3.62	1.37	4.2	23.0	.38	159.3	.18	.50	22.17
D	7.71	579	20.2	37	63	4.43	1.24	4.8	26.8	.46	131.1	.20	.51	19.13
Avg.	6.96	574	20.5	39	61	4.14	1.38	4.4	24.4	.44	138.4	.19	.51	21.15

*From Time Motion Studies

TABLE 8
SELECTED DATA

SYSTEM NUMBER 7, WARWICK, RHODE ISLAND

3 man crew
20 cubic yard rear loaders

One collection per week, curb and alley,
both sides of street
Task incentive

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	10.40	415	10.5	82	18	3.49	.82	2.1	50.1	.50	119.1	.30	.38	15.65
F	9.59	413	10.4	82	18	3.32	.84	1.9	46.4	.48	125.1	.30	.38	16.94
M	11.64	410	10.3	63	37	3.50	.89	2.1	56.7	.51	117.6	.30	.39	14.05
A	13.22	416	10.1	63	37	3.92	1.03	2.3	63.6	.57	106.4	.30	.38	12.30
M	14.55	413	10.5	63	37	4.12	1.10	2.3	70.4	.60	101.0	.30	.38	11.17
J	13.08	409	10.5	69	31	4.11	1.10	2.2	64.0	.60	99.6	.30	.39	12.40
J	12.81	363	10.4	69	31	4.17	1.11	2.1	70.6	.69	87.6	.34	.44	12.73
A	12.49	402	10.3	69	31	4.00	1.02	2.1	62.2	.60	100.8	.31	.40	13.02
S	12.19	408	10.6	76	24	3.87	.95	2.1	59.8	.57	106.9	.31	.39	13.30
O	12.08	406	10.6	76	24	4.02	1.04	2.2	59.6	.59	102.3	.30	.39	13.39
N	17.75	414	11.1	76	24	4.50	1.57	3.0	85.8	.65	92.5	.28	.38	9.11
D	11.63	413	10.7	82	18	3.82	1.12	2.2	56.3	.56	108.4	.29	.39	14.06
Avg.	12.65	407	10.5	72	28	3.91	1.05	2.2	62.4	.58	104.5	.30	.39	12.82

* From Time Motion Studies

TABLE 9
SELECTED DATA

SYSTEM NUMBER 8, OAK PARK, ILLINOIS

3 man crew
25 cubic yard rear loaders

One collection per week, alley only, both sides
8 hour day

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/ Home*	2-Way Items/ Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/ Wk	Cost/Home/Wk	Cost/Ton
J	8.70	307	4.6	59	41	4.75	2.56	1.6	57.9	.95	65.2	.34	.53	18.91
F	7.34	307	4.4	50	50	4.64	2.52	1.4	48.8	.93	66.4	.34	.54	22.42
M	8.94	305	4.2	50	50	4.77	2.58	1.5	59.6	.96	64.0	.35	.54	18.45
A	10.48	310	4.8	50	50	4.78	2.42	1.6	68.8	.95	65.1	.35	.54	15.79
M	11.32	303	4.9	50	50	4.95	2.58	1.7	76.0	1.01	61.2	.36	.55	14.71
J	11.44	305	4.9	50	50	5.19	2.54	1.7	76.9	1.04	58.7	.37	.56	14.88
J	10.33	311	5.0	50	50	5.16	2.40	1.6	68.4	1.02	60.0	.37	.54	16.19
A	10.57	305	4.1	52	48	5.03	2.51	1.7	71.0	1.01	60.6	.36	.55	15.80
S	10.17	305	3.6	52	48	4.85	2.59	1.6	67.8	.97	63.0	.35	.55	16.48
O	10.26	307	4.4	52	48	4.90	2.52	1.6	68.3	.99	63.3	.37	.56	16.48
N	9.53	307	4.1	59	41	4.67	2.48	1.5	63.0	.93	65.6	.35	.55	18.03
D	7.48	304	4.3	59	41	4.89	2.27	1.5	50.5	.99	62.8	.37	.55	22.68
Avg.	9.72	306	4.5	53	47	4.88	2.50	1.6	64.9	.98	62.7	.36	.55	17.13

*From Time Motion Studies

TABLE 10
SELECTED DATA

SYSTEM NUMBER 9, METROPOLITAN DADE COUNTY, FLORIDA

3 man crew
20 cubic yard rear loaders
Task incentive

Two collections per week, curb and alley and both sides of the street

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	13.86	853	10.0	56	44	4.30	1.52	2.3	32.5	.31	204.9	.17	.48	14.93
F	12.92	853	9.6	61	39	3.88	1.49	2.2	30.3	.28	226.9	.16	.48	16.08
M	13.59	853	10.1	61	39	4.20	1.50	2.3	31.9	.30	210.7	.17	.48	15.15
A	13.48	854	10.2	61	39	4.21	1.58	2.3	31.6	.30	209.9	.17	.48	15.28
M	13.90	854	10.0	60	40	4.29	1.44	2.4	32.6	.31	207.0	.17	.48	14.84
J	14.49	853	10.1	60	40	4.82	1.60	2.4	34.0	.34	180.4	.17	.48	14.29
J	16.46	855	9.8	60	40	4.85	1.79	2.5	38.5	.34	179.1	.17	.48	12.83
A	14.15	853	11.5	58	42	4.52	1.62	2.3	33.2	.32	196.2	.17	.48	14.66
S	14.24	853	11.7	58	42	4.51	1.54	2.3	33.4	.32	193.8	.17	.48	14.46
O	13.82	855	10.7	58	42	4.28	1.49	2.3	32.3	.30	204.3	.17	.47	14.91
N	13.61	854	10.4	56	44	4.06	1.45	2.3	31.9	.29	220.2	.17	.48	15.17
D	14.62	852	10.3	56	44	4.60	1.60	2.5	34.3	.33	190.6	.17	.48	14.19
Avg.	14.10	854	10.4	59	41	4.38	1.55	2.3	33.1	.31	200.5	.17	.48	14.67

*From Time Motion Studies

TABLE 11
SELECTED DATA

SYSTEM NUMBER 10, SAN LEANDRO, CALIFORNIA

2 man crew
20 cubic yard rear loaders
Task incentive

One collection per week
Backyard service, both sides of the street

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	5.96	362	7.1	6	94	5.05	.95	1.0	32.9	.84	71.8	.27	.33	20.15
F	6.19	361	7.1	2	98	5.14	.95	1.0	34.3	.85	70.3	.27	.32	19.15
M	6.08	358	6.9	2	98	4.89	1.07	1.0	34.0	.82	73.3	.27	.33	19.90
A	6.17	361	8.4	2	98	4.94	1.08	1.0	34.2	.82	73.0	.26	.32	19.20
M	6.28	361	7.1	3	97	4.94	1.07	1.0	34.9	.82	73.0	.27	.33	19.14
J	6.02	361	6.9	3	97	5.02	1.04	1.0	33.3	.83	72.1	.27	.32	19.69
J	6.09	361	7.3	3	97	5.00	1.04	1.0	33.7	.83	72.2	.27	.33	19.79
A	6.47	377	6.3	6	94	5.16	.88	1.0	34.4	.82	73.1	.26	.31	18.41
S	6.35	374	5.7	6	94	5.08	.94	1.0	34.1	.82	73.6	.26	.31	18.56
O	6.21	375	6.0	6	94	5.12	.99	1.0	33.2	.82	73.1	.26	.31	19.08
N	6.33	361	7.0	6	94	5.22	.91	1.0	35.1	.87	69.2	.27	.32	18.72
D	6.01	360	6.6	6	94	5.10	.88	1.0	33.4	.85	70.8	.27	.32	19.75
Avg.	6.18	364	6.9	4	96	5.06	.98	1.0	33.9	.83	72.1	.27	.32	19.26

* From Time Motion Studies

TABLE 12
SELECTED DATA

SYSTEM NUMBER 11, RACINE, WISCONSIN

2 man crew
16 and 20 cubic yard rear loaders

One collection per week
Backyard service using tote barrel
8 hour day

Month	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll/Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
J	5.11	244	6.9	41	59	5.47	1.19	1.9	42.2	1.35	44.7	.38	.47	23.07
F	4.58	245	6.3	41	59	5.43	1.19	1.8	37.4	1.34	45.4	.37	.46	24.91
M	5.50	245	5.7	41	59	5.52	1.11	1.8	44.9	1.36	44.6	.38	.46	20.69
A	6.44	244	6.2	51	49	5.31	1.37	1.8	52.9	1.31	46.2	.36	.46	17.88
M	7.83	246	6.1	51	49	5.43	1.27	2.0	63.7	1.33	45.5	.37	.46	14.67
J	7.71	237	6.9	51	49	5.48	1.33	2.0	65.3	1.39	43.3	.38	.48	14.93
J	6.81	245	7.0	48	52	5.61	1.26	1.9	55.9	1.38	43.6	.37	.46	16.66
A	6.63	244	8.0	48	52	5.56	1.22	1.9	54.6	1.37	43.9	.37	.46	17.07
S	6.81	245	6.4	48	52	5.42	1.30	1.9	55.8	1.33	45.3	.37	.46	16.83
O	6.21	232	5.5	40	60	5.43	1.34	1.9	53.8	1.41	42.8	.39	.48	18.28
N	6.17	241	6.5	40	60	5.50	1.20	2.0	51.3	1.38	43.9	.38	.46	18.35
D.	4.84	241	6.6	40	60	5.45	1.31	1.9	40.3	1.36	44.5	.37	.46	23.56
Avg.	6.18	243	6.6	45	55	5.47	1.25	1.9	51.1	1.36	44.4	.37	.47	18.41

* From Time Motion Studies

TABLE 13
SELECTED DATA

YEARLY AVERAGES BY SYSTEM

System Number	Tons/Day	Homes/Day	Coll Miles/Day	1-Way Items/Home*	2-Way Items/Home*	Coll Hrs/Day	Trans Hrs/Day	Loads/Day	Lbs/Home/Coll	Min/Home/Coll	Homes/Coll Hr	Coll Cost/Home/Wk	Cost/Home/Wk	Cost/Ton
1	9.44	410	10.5	48	52	3.83	1.71	1.8	46.2	.56	107.3	.13	.19	8.29
2	9.00	254	6.1	47	53	4.56	2.01	1.6	71.0	1.08	55.7	.20	.30	8.46
3	5.73	410	13.7	47	53	4.88	1.07	1.0	28.2	.72	84.2	.29	.38	17.13
4	12.62	512	10.1	72	28	4.82	1.92	2.4	49.3	.56	107.0	.16	.23	9.53
5	14.49	575	13.1	94	6	4.67	1.75	1.9	50.5	.49	123.3	.15	.22	8.72
6	6.96	574	20.5	39	61	4.14	1.38	4.4	24.4	.44	138.4	.37	.51	21.15
7	12.65	407	10.5	72	28	3.91	1.05	2.2	62.2	.58	104.5	.30	.39	12.82
8	9.72	306	4.5	53	47	4.88	2.50	1.6	64.9	.98	62.7	.36	.55	17.13
9	14.10	854	10.4	59	41	4.38	1.55	2.3	33.1	.31	200.5	.34	.48	14.67
10	6.18	364	6.9	4	96	5.06	.98	1.0	33.9	.83	72.1	.27	.32	19.26
11	6.18	243	6.6	45	55	5.47	1.25	1.9	51.1	1.36	44.4	.37	.47	18.41

*From Time Motion Studies

TABLE 14

GENERATION RATE IN POUNDS PER HOME PER WEEK BY SYSTEM

SYSTEM NUMBER	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	36.3	37.0	43.2	46.5	55.7	52.3	52.3	55.2	47.6	44.1	44.9	38.8
2	63.2	73.0	74.7	77.2	80.9	78.0	80.2	66.1	69.4	66.9	68.0	63.8
3	50.6	54.9	63.2	65.4	62.7	57.4	61.4	56.0	51.9	50.1	49.9	50.2
4	38.8	36.1	45.1	54.0	61.9	61.3	----	----	52.2	53.3	50.3	37.9
5	46.5	44.4	52.9	55.4	----	60.6	47.1	48.5	----	55.8	52.6	46.6
6	43.5	49.4	46.4	50.5	48.1	48.7	55.4	48.2	49.3	46.4	46.0	53.6
7	50.1	46.4	56.7	63.6	70.4	64.0	70.6	62.2	59.8	59.6	85.8	56.3
8	57.9	48.8	59.6	68.8	76.0	76.9	68.4	71.0	67.8	68.3	63.0	50.5
9	65.0	60.6	63.8	63.2	65.2	68.0	76.9	66.4	66.8	64.7	63.8	68.6
10	32.9	34.3	34.0	34.2	34.9	33.3	33.7	34.4	34.1	33.2	35.1	33.4
11	42.2	37.4	44.9	52.9	63.7	65.3	55.9	54.6	55.8	53.8	51.3	40.3

TABLE 15

COLLECTION RATE IN TONS PER CREW PER DAY BY SYSTEM

SYSTEM NUMBER	MONTHS												AVERAGE TONS PER DAY PER YEAR TOTALS
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	
1	7.35	7.49	8.99	9.43	11.33	10.76	10.73	11.30	9.78	8.93	9.25	7.88	9.44
2	7.87	8.98	9.25	9.41	10.07	9.51	10.32	9.93	8.50	8.38	8.40	8.06	9.00
3	4.99	5.33	6.34	6.72	6.43	5.91	6.41	5.75	5.33	5.15	5.09	5.11	5.73
4	9.72	9.09	11.42	13.92	16.25	15.99	-----	-----	13.50	13.60	13.02	9.55	12.62
5	13.15	12.47	16.15	15.55	-----	17.41	12.69	15.27	-----	15.03	15.27	13.23	14.49
6	6.18	7.06	6.62	7.25	6.83	6.90	7.91	6.96	7.09	6.53	6.55	7.71	6.96
7	10.40	9.59	11.64	13.22	14.55	13.08	12.81	12.49	12.19	12.08	17.75	11.63	12.65
8	8.70	7.34	8.94	10.48	11.32	11.44	10.33	10.57	10.17	10.26	9.53	7.48	9.72
9	13.86	12.92	13.59	13.48	13.90	14.49	16.46	14.15	14.24	13.82	13.61	14.62	14.10
10	5.96	6.19	6.08	6.17	6.28	6.02	6.09	6.47	6.35	6.21	6.33	6.01	6.18
11	5.11	4.58	5.50	6.44	7.83	7.71	6.81	6.63	6.81	6.21	6.17	4.84	6.18

FIGURE 5

WASTE RATES - SYSTEM 1

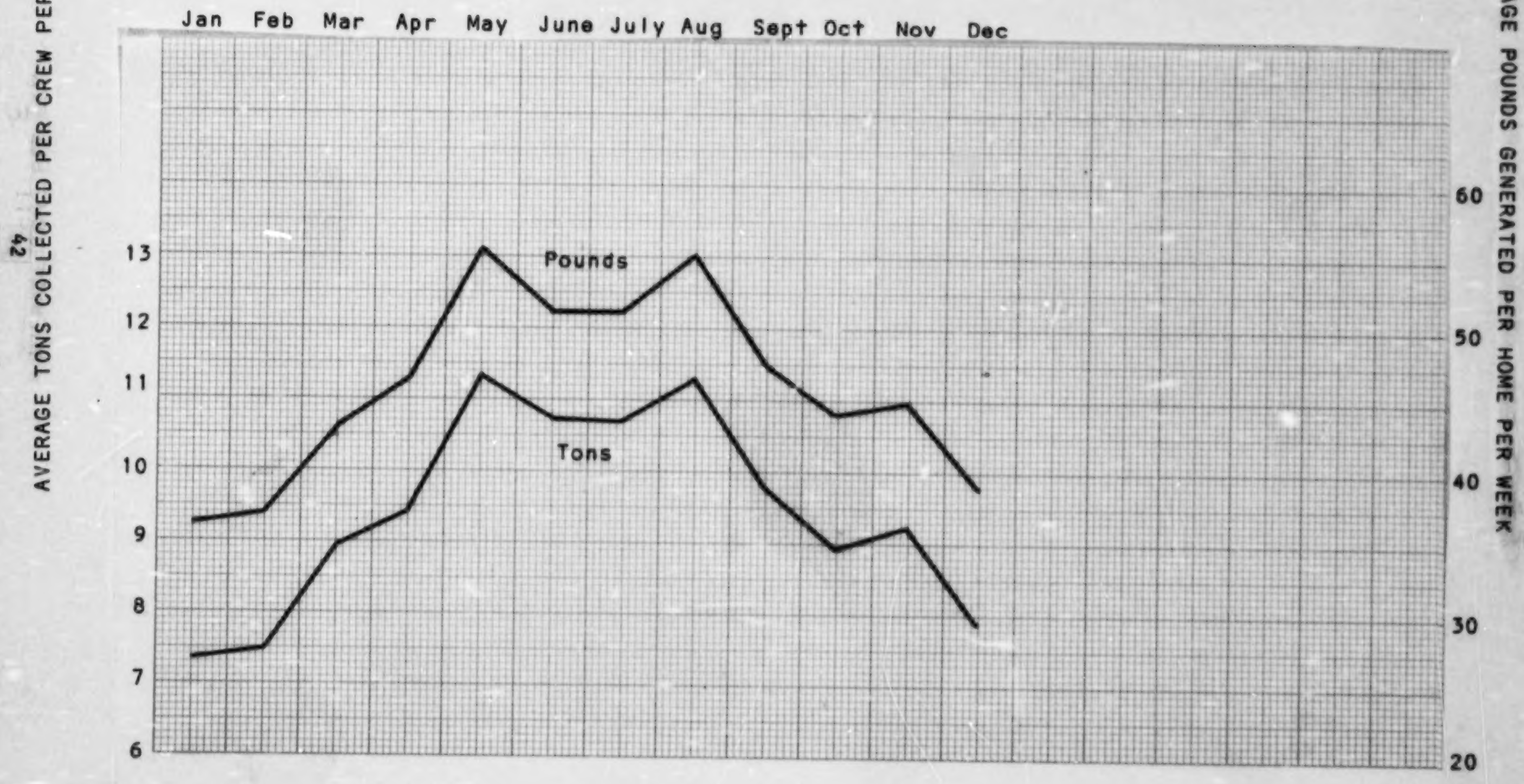


FIGURE 6

WASTE RATES - SYSTEM 2

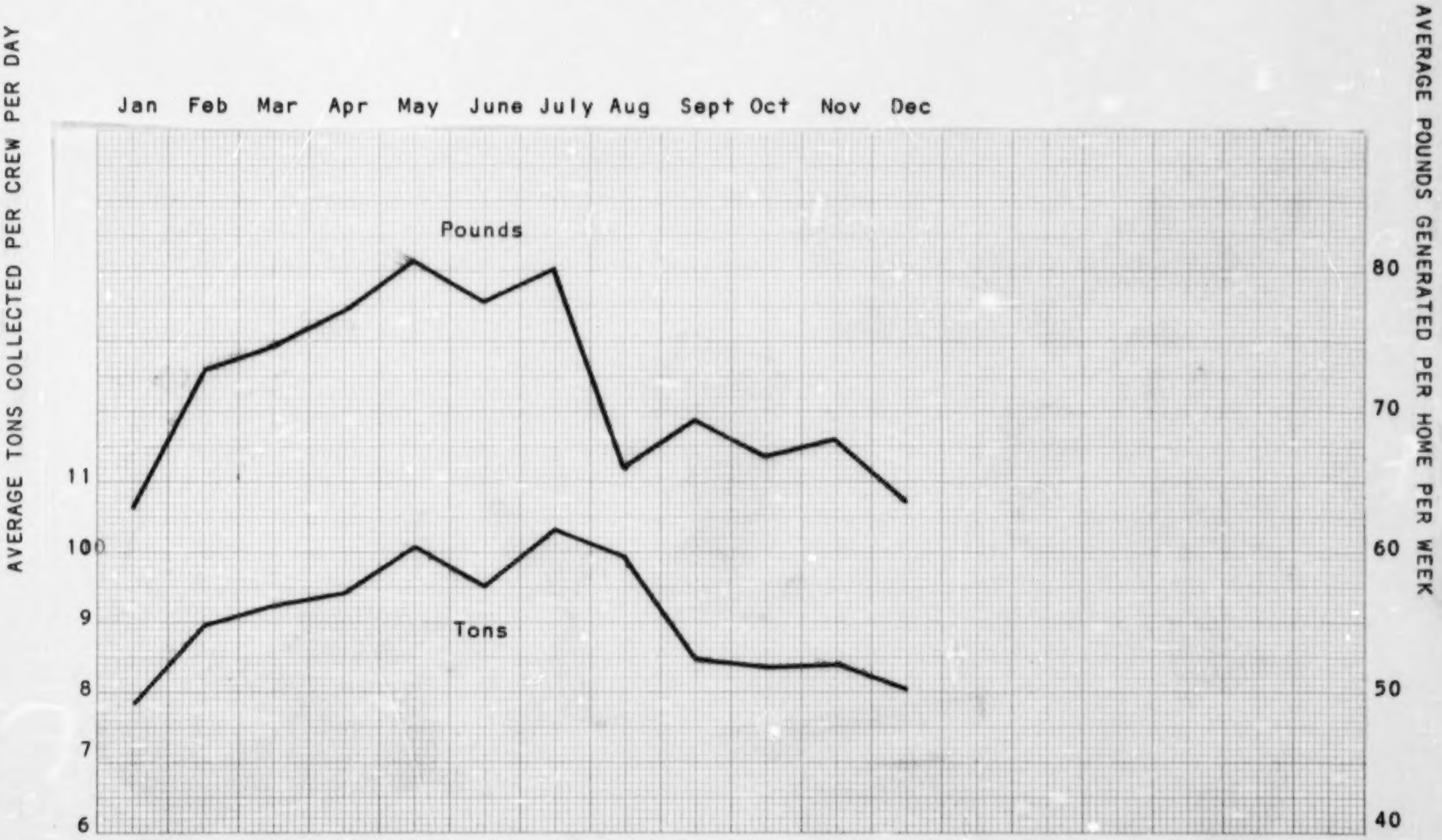


FIGURE 7

WASTE RATES - SYSTEM 3

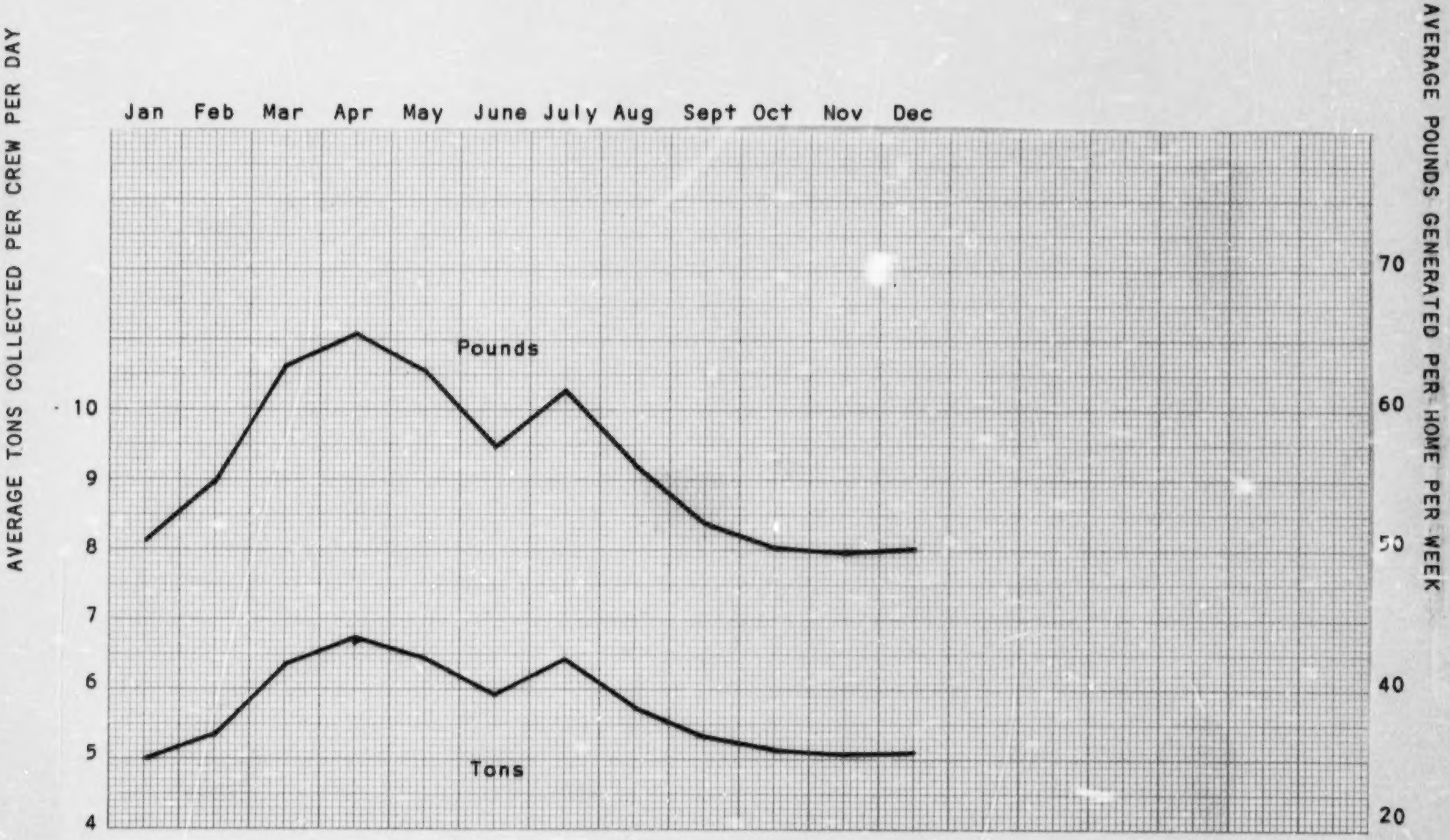


FIGURE 8

WASTE RATES - SYSTEM 4

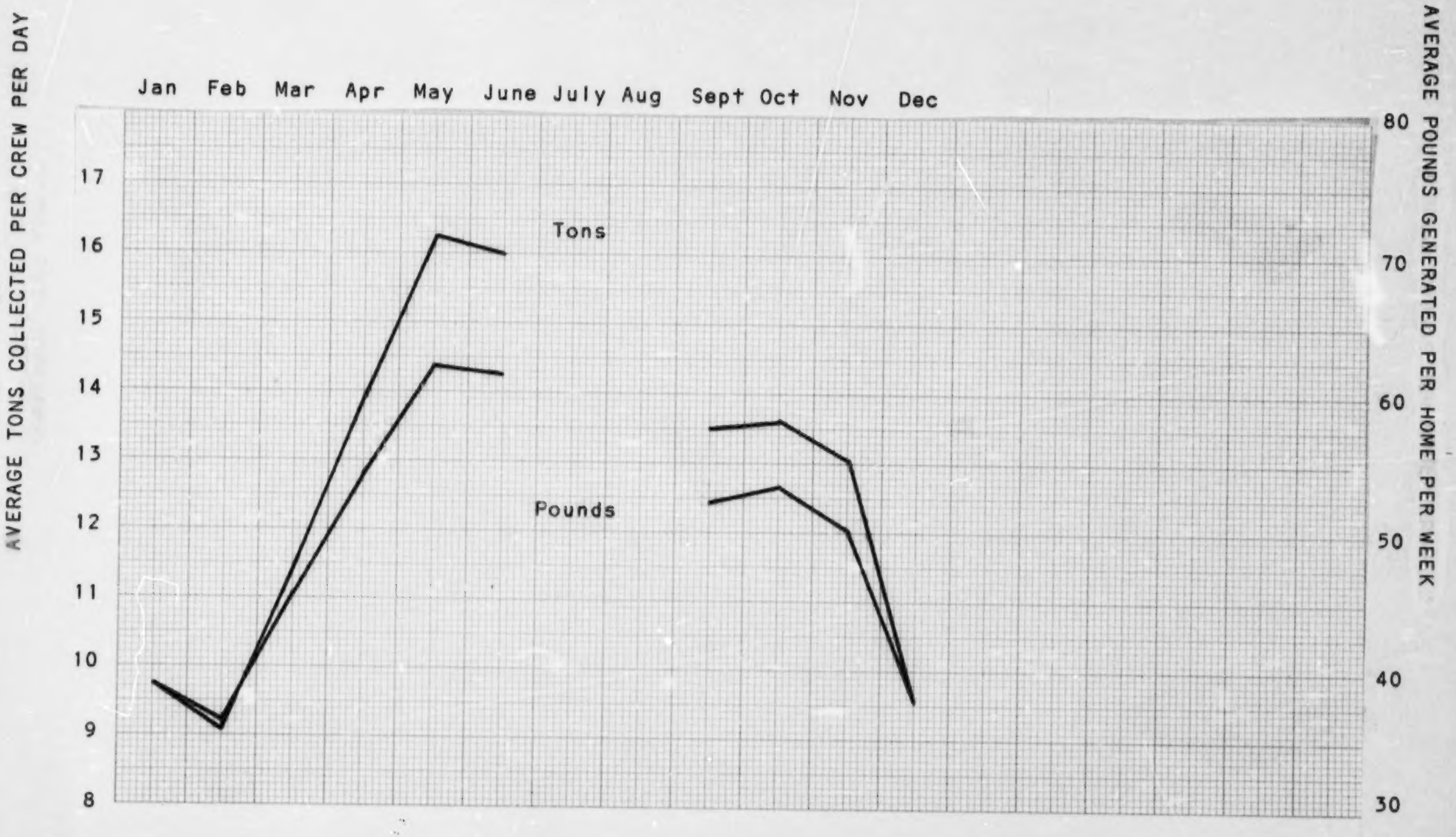


FIGURE 9

WASTE RATES - SYSTEM 5

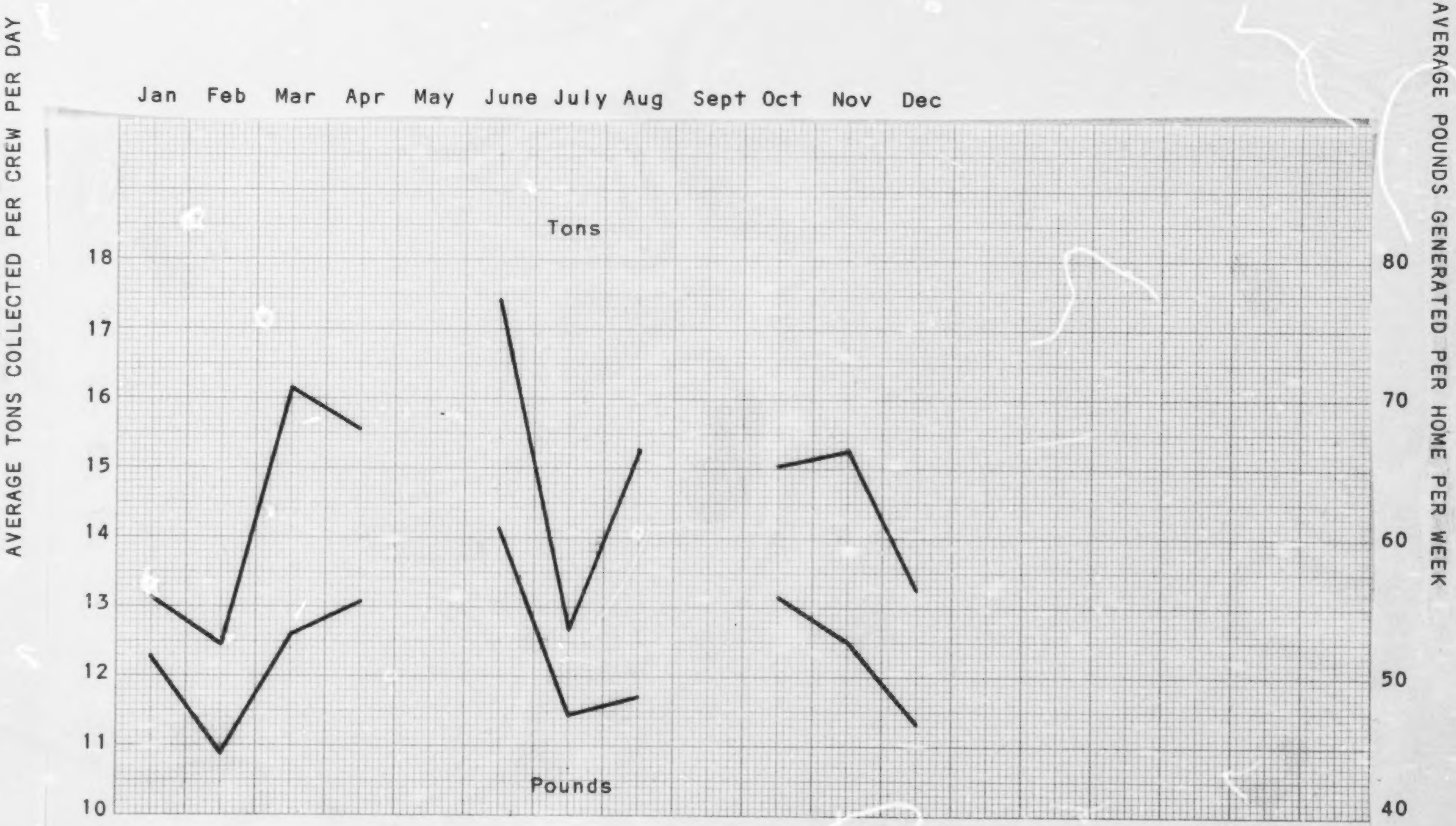


FIGURE 10

WASTE RATES - SYSTEM 6

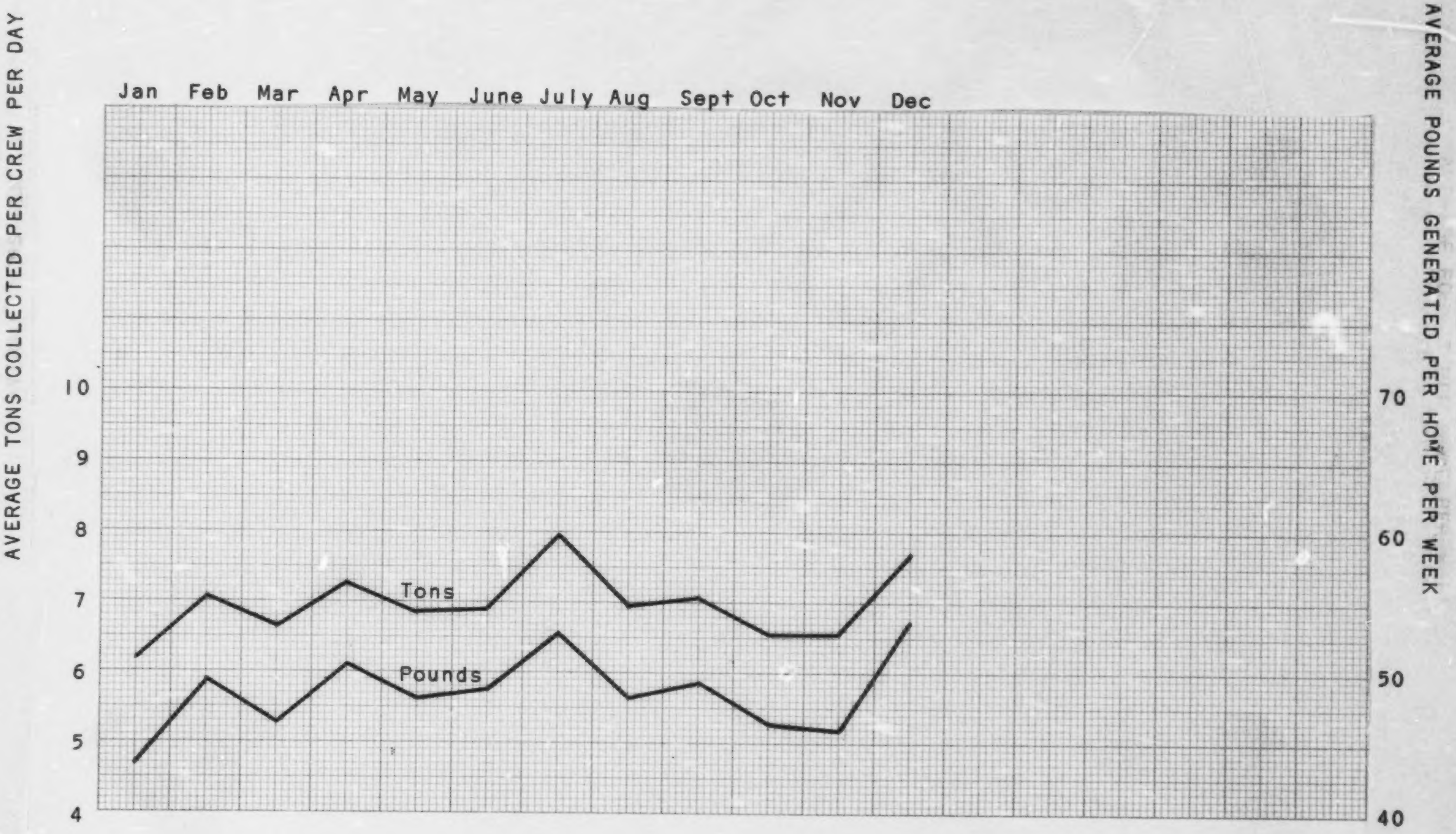


FIGURE 11

WASTE RATES - SYSTEM 7

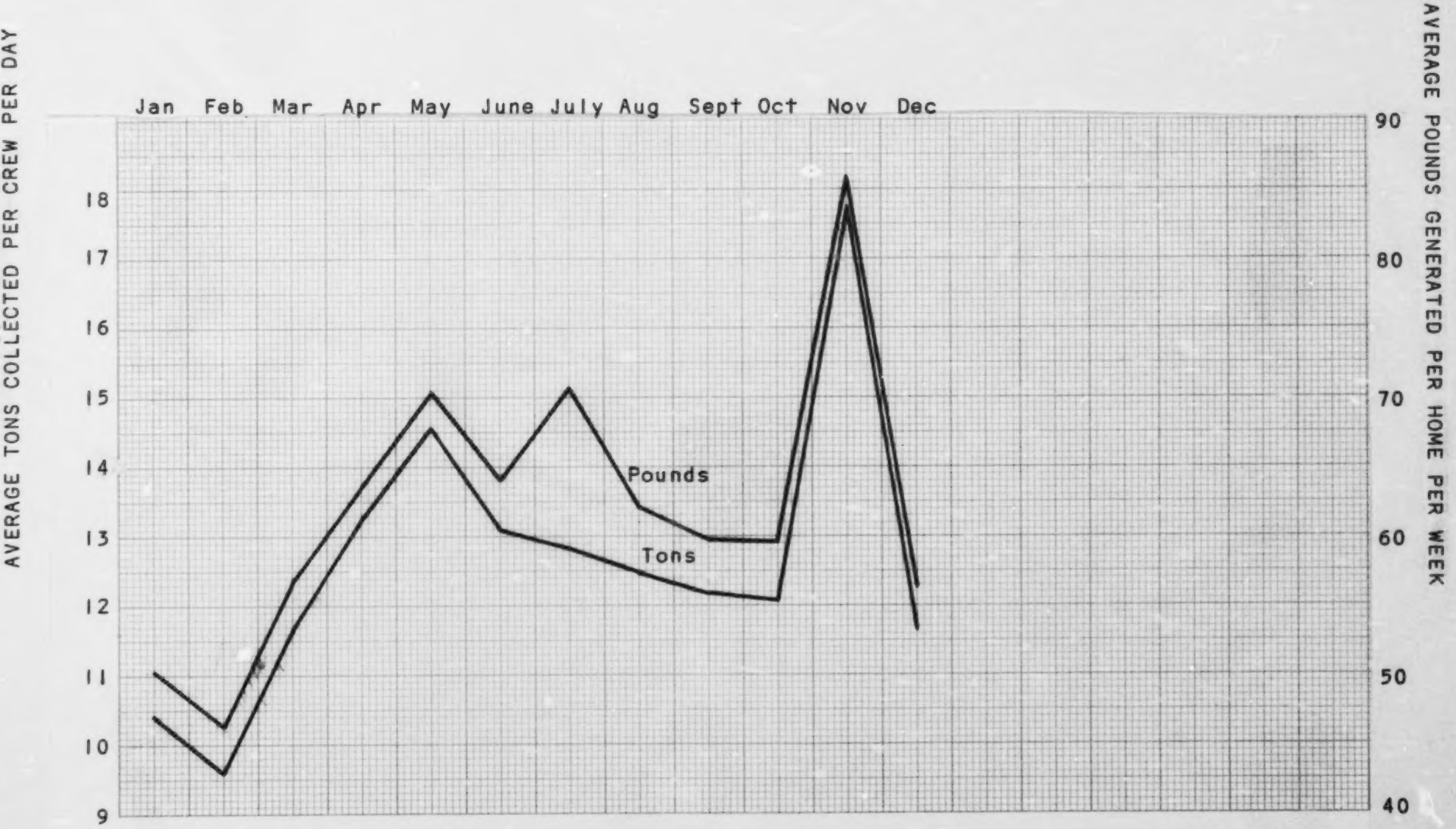


FIGURE 12

WASTE RATES - SYSTEM 8

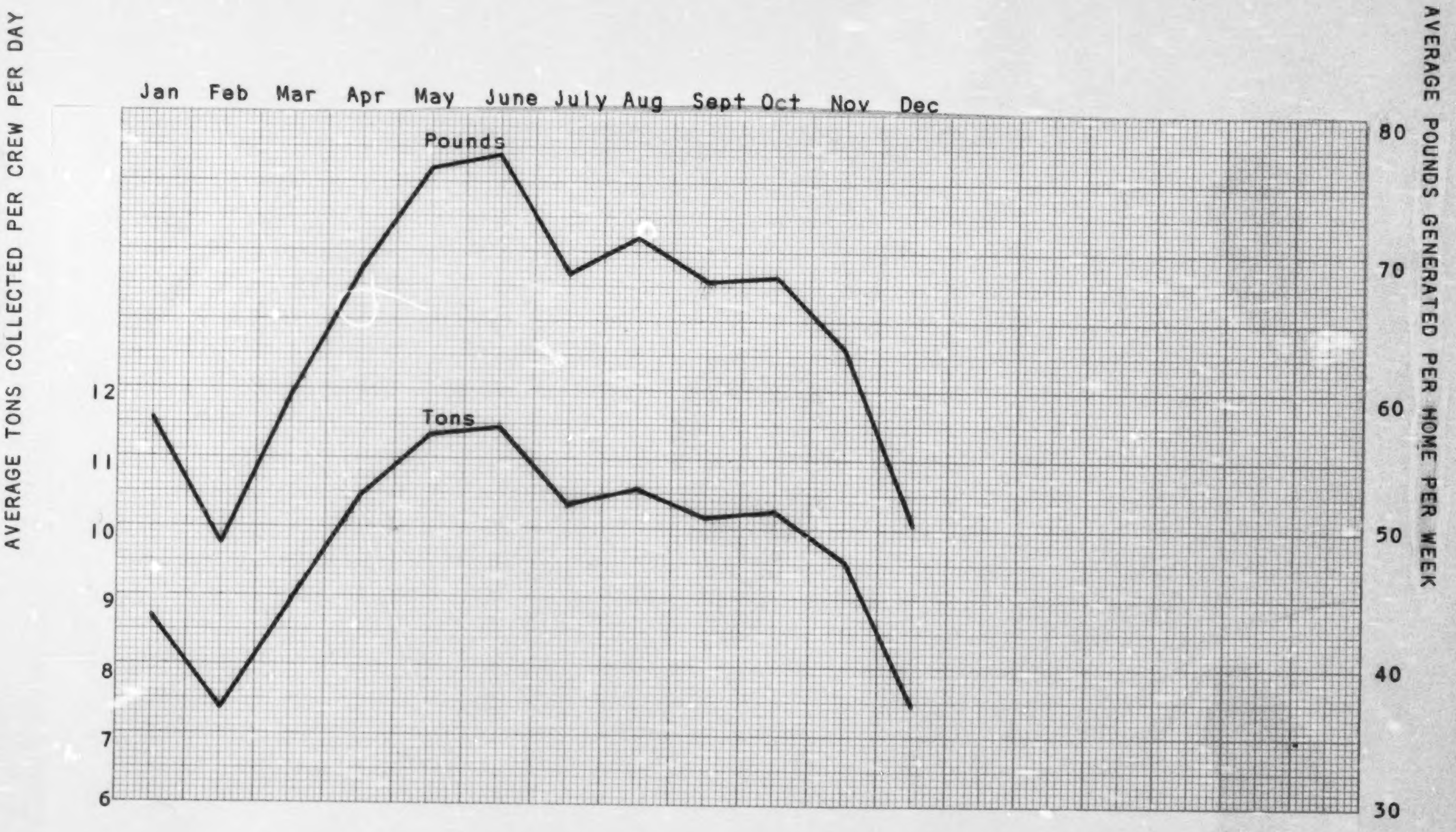


FIGURE 13

WASTE RATES - SYSTEM 9

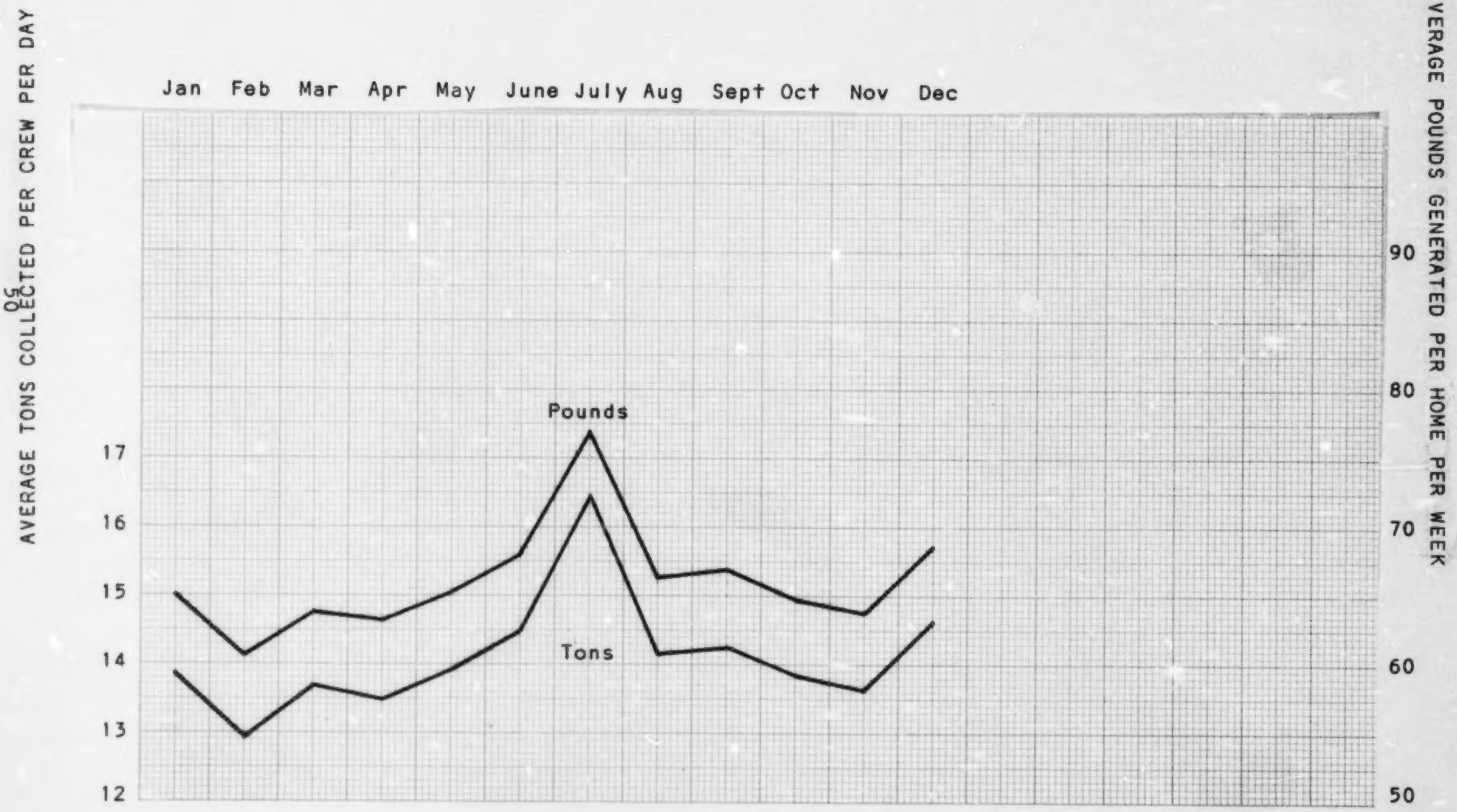


FIGURE 14

WASTE RATES - SYSTEM 10

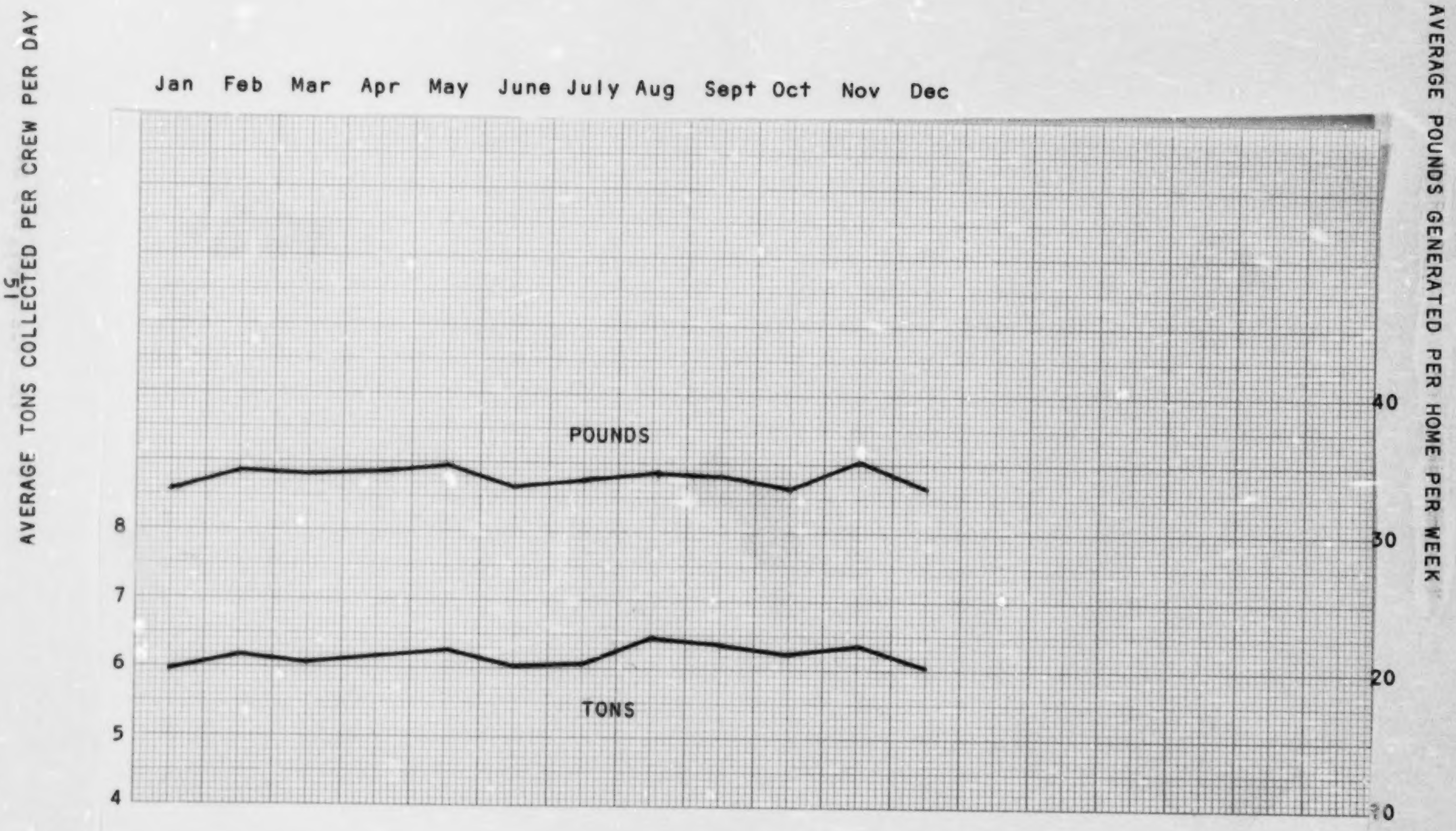


FIGURE 15

WASTE RATES - SYSTEM II

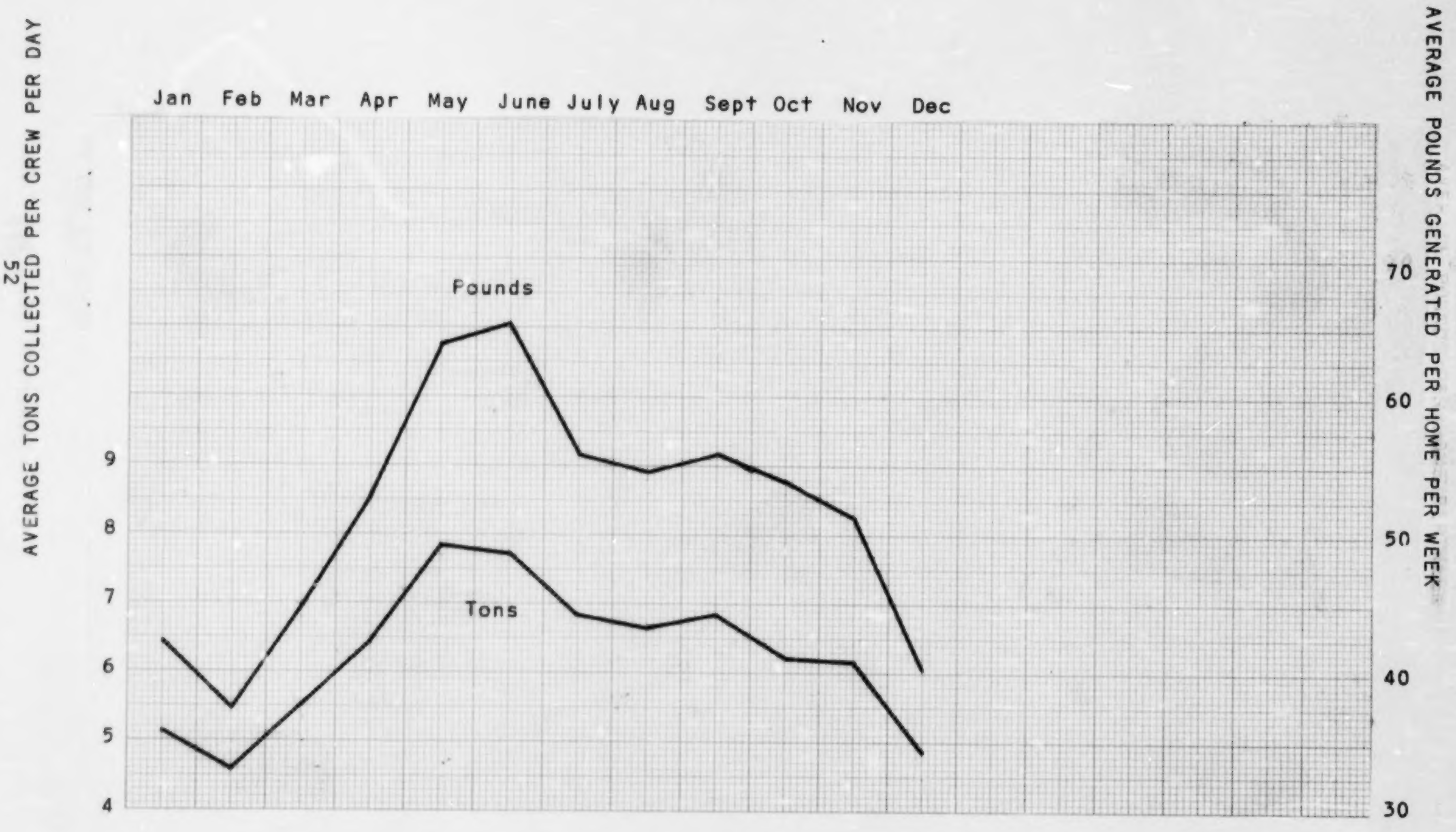


FIGURE 16
Average Homes Served Per Week

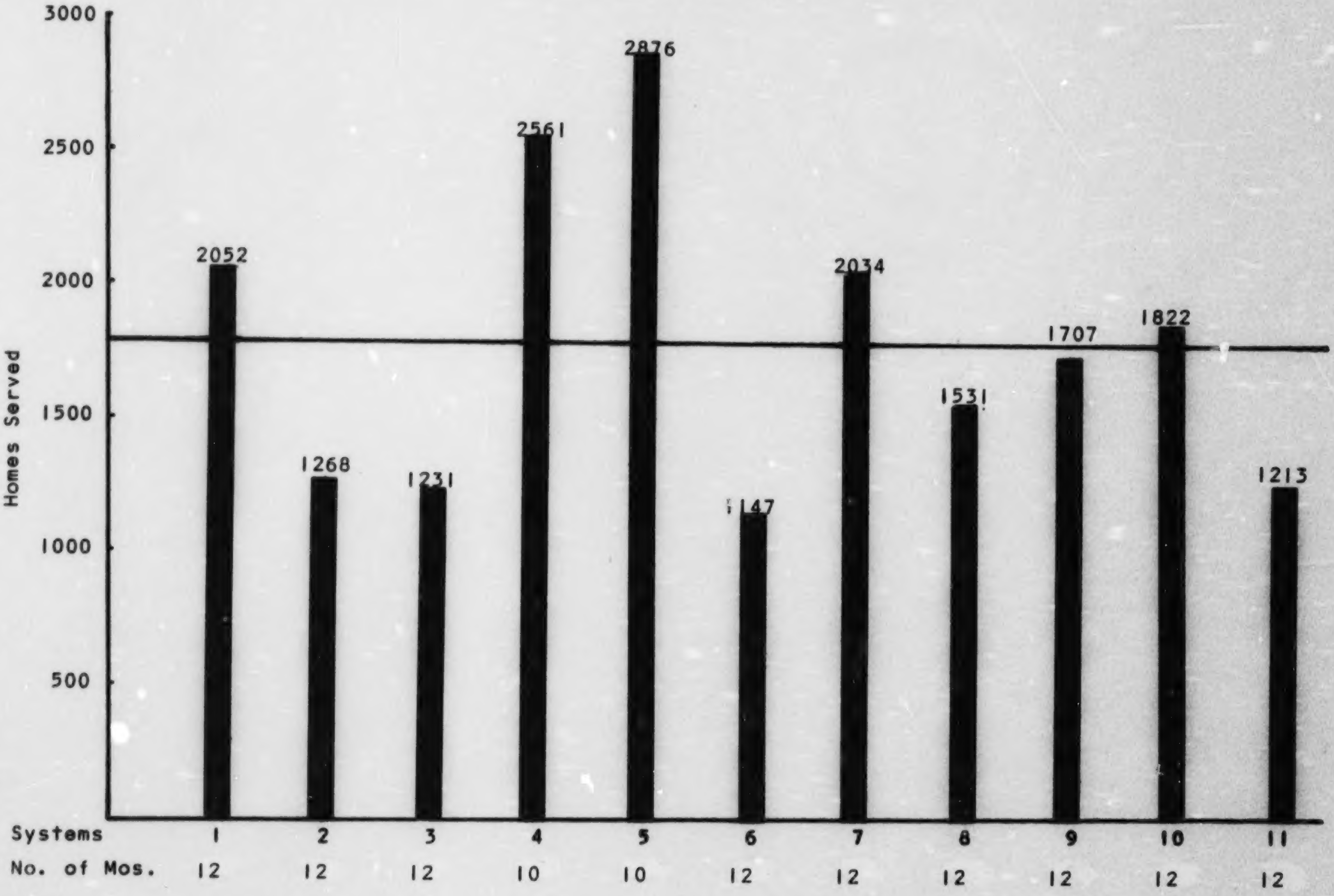


FIGURE 17
Average Weight Per Home Per Week

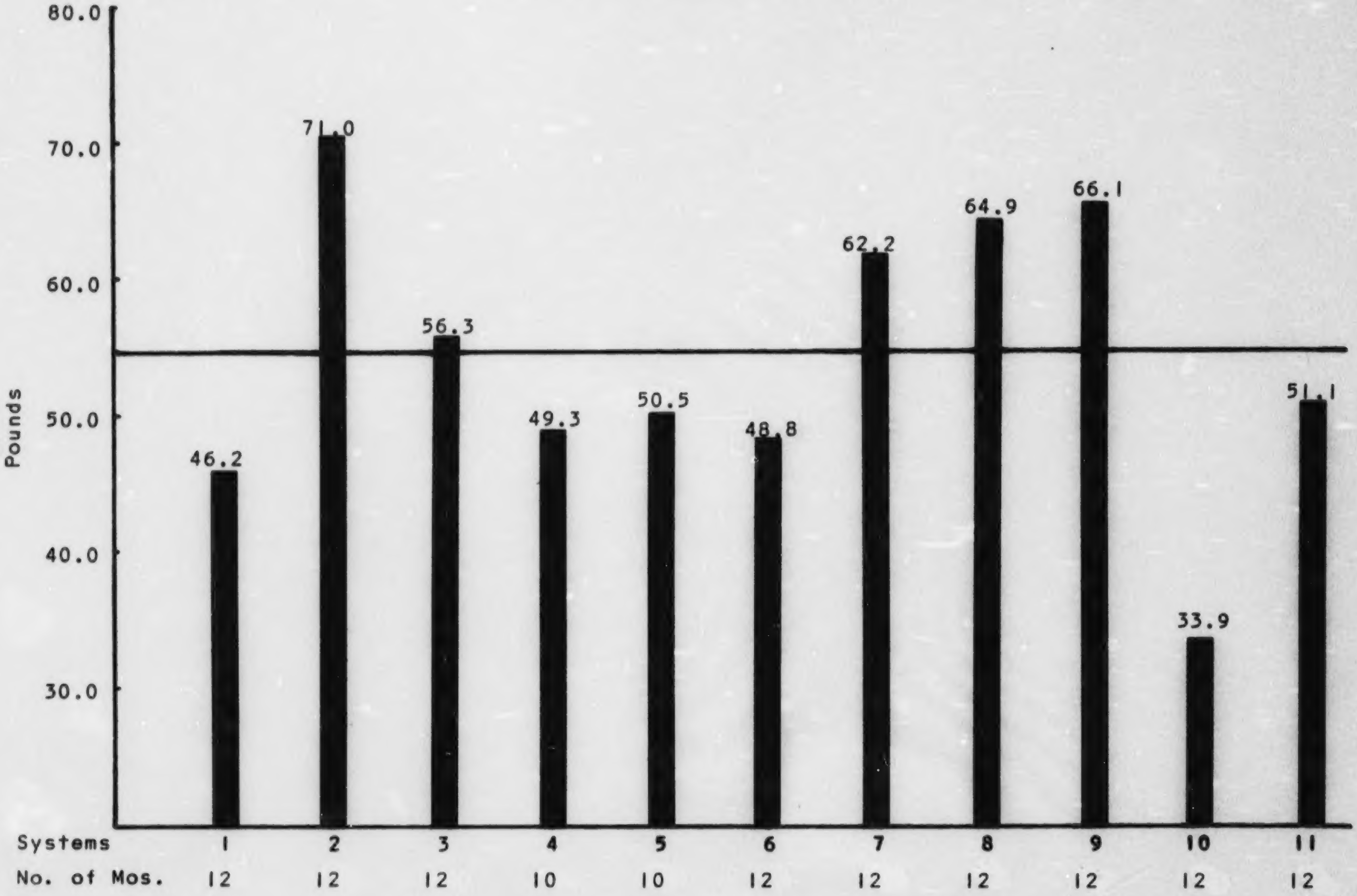
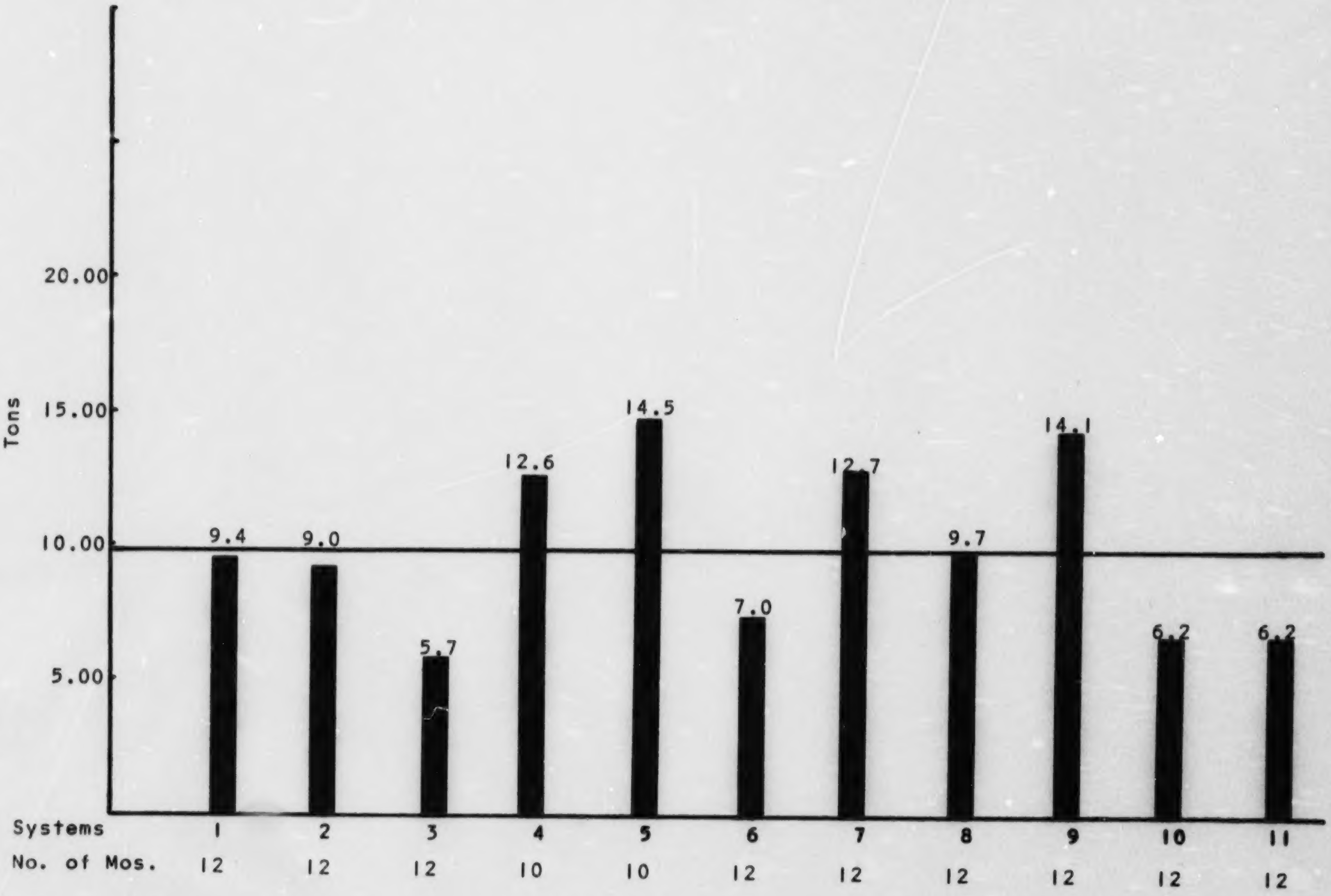


FIGURE 18
Average Weight Collected Per Day



SECTION III

ANALYSIS OF STUDY DATA

Collection System Productivity and Cost Efficiency

In general, there is considerable confusion regarding the terms production, productivity and efficiency. The following concepts will apply for the purposes of this report.

Production, as it pertains to residential solid waste collection activities, is the total output of a work effort in terms of homes served per day and total weight collected. The concept of production applies to every organizational element from the individual route up to and including the highest level (city or company). Production in a residential collection operation can be increased by adding more resources. A manager can increase the number of homes served per day and the number of tons collected by increasing the size of his crews or by adding more crews or by a combination of these methods. Both procedures are followed extensively in practice.

Productivity is the production or output of an organizational element related to the resources used to obtain that production. Thus, if two organizational elements have the same production with the same input of resources the productivity will be equal for both elements. However, if greater production is achieved with the same input of resources or if a constant level of output is achieved with a smaller input of resources, the productivity will be increased. Thus, a manager can also increase production by increasing productivity.

For this report the basic productivity measures will be homes served per crewman per collection hour and tons collected per crewman per collection hour. That is, output is related to manpower input. For information purposes, the less meaningful productivity measures of homes served per crew per collection hour and tons collected per crew per collection hour are also presented. In this case, if three crews collected 100 homes per hour the production of the three crews would be the same. If these three crews consisted of one man, two men and three men respectively, the true productivity of the crews would be significantly different. The one man crew would have the highest productivity because the input in terms of people was the least. The productivity of the three man crew would be the smallest because the input of people was greatest.

Another productivity concept that is included in this report is marginal productivity. In this concept the incremental effect of adding a crewman is determined. This incremental effect can then be compared to the crew performance with and without the additional crew member. The marginal productivities will also be measured in terms of homes served per collection hour and tons collected per collection hour. For example, an additional crewman may increase or decrease the productivities of the other crewmen. If the additional crewman is able to produce more than the other crewmen and if he helps the other crewmen to produce more, then adding the additional crewman is beneficial. If the additional crewman produces less than the other crewmen and as a result the entire crew produces less on a per crewman basis, then adding the additional crewman is detrimental.

The discussion of productivity has been limited to activities in terms of collection hours. Collection hours are used to provide a uniform and easily recognized unit for comparison purposes. Because of the individual circumstances surrounding the systems in this study, there were different round trip transport distances and times, different dump times and a different number of loads per day. On a daily basis these differences would have a significant impact on productivity. It is interesting to note, however, that for two systems using the same equipment with the same round trip transport time, the same number of loads per day and the same on route productivity, then the productivity per crewman will be the same for each crew regardless of the crew size.

Occasionally, in this report, productivity will be discussed in terms of total effort per day as well as per collection hour. In general, productivity in terms of collection hours relates to the "on-route" activities. Whenever activities for the entire day are considered, the word "total" will be used.

While it is possible to design a single index to indicate the level of productivity for various residential collection systems, this approach was not considered for this report. Single indices are subject to misinterpretation and are controversial at best. No single item, by itself, will permit a valid comparison of system productivities. Instead, it is necessary to look at each factor separately in order to compare system operations.

In place of a single index the productivity factors for the various systems are related to the same factors for System I. System I, in this study, is considered to be the basic system because it is the simplest in concept. System I is also the most productive in output in terms of input. System I consists of a side loading vehicle which can be loaded and driven from either side; a crew size of one; collects once weekly, from the curb, from one side of the street at a time; and uses the task incentive system. Later in this report these indices are presented. In all cases the index is the performance value of a compared system divided by the performance value for System I.

For comparative purposes the most meaningful system performance measure is the collection cost efficiency index. This index, as used in this report, associates the concept of productivity with collection cost. Again, cost efficiency may be examined on an on-route or total day basis.

The organization that achieves a given level of productivity at least costs has the greatest collection cost efficiency. For example, if two crews have exactly the same performance parameters per day in terms of homes served, weight collected, miles traveled and time worked, their productivity would be exactly the same. If one crew was using a new vehicle of 20 cubic yards capacity and the other crew was using one of 25 cubic yards capacity, then the crew that was using the vehicle of 20 cubic yards capacity would have the greater cost efficiency. The reason for this is that the 25 cubic yard vehicle would cost more, and this additional cost would be reflected as an additional incremental cost for each parameter being considered. Therefore, the concept of collection cost efficiency takes into account the various costs that are associated with the collection operation. The organization that has the greatest productivity at the least cost would have the best collection cost efficiency. By analogy, the system that has a collection cost per home of $0.13 per week is more efficient than systems with a collection cost per home per week greater than $0.13.

Before presenting the productivity and cost efficiency results of the systems under study, it is necessary to discuss the multivariable nature of solid waste collection and the comparability of systems. There are many community and system variables that impact on productivity and cost efficiency. These variables are so interrelated and dependent upon each other that it is extremely difficult to identify the full impact of any single variable. Thus, when comparing systems, it is necessary to take into account as many of these variables as possible while holding constant as many variables as possible. Variables easily held constant in comparing systems include: point of collection, frequency of collection, crew size, incentive system and vehicle size and type. Other variables are difficult, if not impossible, to hold constant. They include amount of waste, type and number of storage devices, housing density, collection methodology, traffic, and street to storage distance. Because the nature and effect of a variable may, at times, be impossible to identify and define, even experienced analysts may have difficulty in deciding which of two systems is better. It is also possible to overlook an important variable and make an invalid conclusion. With these cautioning remarks in mind, the next portions of the report present an analysis of the data that were obtained during the study. In making the analysis the objective is to highlight the significant impact of the variable being considered. The values reported are those that resulted from this study effort. They may not represent the situation in any other system; however, the relationships that are developed should apply generally. For example, the results clearly show that curbside is more productive and cost efficient than backyard service, but for any given system, other factors may make this difference more or less than that reported from the study.

Table 16 summarizes the productivity and cost efficiency measures discussed for the systems under study.

Presentation of System Productivity and Efficiency Measures

The performance of each system in the study is summarized in Table 17. This table consists of selected items of information related to productivity and cost efficiency. This information was extracted from the DAAP and time motion reports.

The table is divided into several sections. At the top of the table is a description of each system. The data are grouped by curb/alley systems and backyard systems, then by frequency of collection and by crew size.

The second section shows percent of total crew time spent on various activities. Data in this section are derived from the DAAP and the time motion reports. The percent of time spent in going to the route and in transporting waste is derived from the DAAP report. The remaining time is collection time. The breakdown of the collection time for the curb/alley systems is based on data from the time motion reports.

The third section summarizes the productive and non-productive crew times for each of the systems studied. In the collection phase of operations the waiting and other time are considered non-productive. In going to the route and the transport phases of the operation only the driver is considered to be productive.

The fourth section summarizes the route characteristics for each system to enable direct comparisons to be made among systems.

In the fifth section, productivity factors as they relate to the performance of the crew and the performance of a crewman are provided. The productivity factors are in terms of services per

TABLE 16

SUMMARY OF PRODUCTIVITY AND COST EFFICIENCY MEASURES

	PRODUCTIVITY MEASURES*	COST EFFICIENCY MEASURES*
On-Route	homes/crewman/collection hour** tons/crewman/collection hour** homes/crew/collection hour tons/crew/collection hour	collection cost/home/week collection cost/home/year** collection cost/ton**
Total Day	homes/crewman/day** tons/crewman/day** homes/crew/day tons/crew/day	total cost/home/week total cost/home/year** total cost/ton**

* Each of these figures also has an associated marginal productivity and cost efficiency measure (e.g., marginal homes/crewman/collection hour).

** For system comparisons, these are the most useful measures.

Table 17

SYSTEMS PRODUCTIVITY AND EFFICIENCY MEASURES

SYSTEM DEFINITION												
CHARACTERISTICS		CURB-ALLEY SYSTEMS									BACKYARD SYSTEMS	
System Number		1	2	4	5	7	8	3	6	9	10	11
Collections/Week		1	1	1	1	1	1	2	2	2	1	1
Crew Size		1	1	2	2	3	3	1	2	3	2	2
Incentive System		Task	Std dy	Task	Std dy	Task	Std dy	Task	Task	Task	Task	Std dy
Collection Pattern		1 side	1 side	1 side	1 side	Both sides	Both sides	1 side	1 side	Both sides	Tote barrel	Tote barrel
Vehicle Size (Cu Yds) & Type		25 SL	25 SL	20 RL	25 RL	20 RL	25 RL	33 SL	8-DC	20 RL	20 RL	13 RL
ACTIVITY		PERCENT OF TOTAL CREW TIME SPENT ON ACTIVITY										
To Route And Transport		34.8	32.2	31.5	30.2	24.2	35.4	22.6	27.2	30.0	18.3	20.6
ON ROUTE	Driving*	17.9	13.5	8.9	12.2	5.8	3.1	24.7	10.0	7.2	----	----
	Riding* - Walking	0.0	0.0	7.8	11.6	11.8	5.8	0.2	18.1	14.5	----	----
	Collecting	45.8	51.5	30.6	19.5	35.7	38.2	50.1	27.8	29.3	81.7	79.4
	Waiting**#	0.8	1.8	20.8	26.4	22.2	17.3	1.1	6.5	18.5	----	----
	Other**	0.7	1.0	0.4	0.2	0.5	0.4	1.3	10.4	0.5	----	----
* Driving = Riding For 1-Man Systems **Non-productive Time # Waiting includes compaction delays		TOTAL TIME UTILIZATION (PERCENT)										
Crew Productive Time		98.5	97.2	63.0	58.3	61.3	58.7	97.6	69.5	61.0	----	----
Crew Non-Productive Time		1.5	2.8	37.0	41.7	38.7	41.3	2.4	30.5	39.0	----	----
Total		100	100	100	100	100	100	100	100	100	----	----
ROUTE CHARACTERISTICS (DAILY AVERAGES)												
Pounds/Home/Collection		46.2	71.0	49.3	50.5	62.2	64.9	28.2	24.4	33.1	33.9	51.1
Percent Bags/Number Per Home Per Collection		34/1.5	26/1.3	56/2.6	85/4.6	56/3.6	25/1.5	29/0.9	19/0.5	46/1.2	2/0.0	33/1.4
Percent Cans/Number Per Home Per Collection		52/2.3	53/2.7	28/1.3	6/0.4	28/1.5	47/2.7	53/1.6	61/1.5	41/1.	96/1.2	55/2.4
Percent Misc/Number Per Home Per Collection		14/0.7	21/1.1	16/0.7	9/0.5	16/1.0	28/1.7	18/0.5	20/0.5	13/0.4	2/0.0	12/0.5
On Route Miles/Day		10.5	6.1	10.1	13.1	10.5	4.5	13.7	20.5	10.4	6.9	6.6
Transport Miles/Day		46.1	18.8	32.6	29.9	14.3	34.4	22.2	12.0	33.4	6.0	17.6
On Route Hours/Day		3.83	4.56	4.82	4.67	3.91	4.88	4.88	4.14	4.38	5.06	5.47
Transport Hours/Day		1.71	2.01	1.92	1.75	1.05	2.50	1.07	1.38	1.55	0.98	1.25
Hours Worked/Day		5.87	6.71	7.02	6.69	5.16	7.57	6.32	5.69	6.26	6.19	6.89
Loads/Day		1.8	1.6	2.4	1.9	2.2	1.6	1.0	4.4	2.3	1.0	1.9
Services/Day		410	254	512	575	407	306	410	574	854	364	243
Tons/Day		9.44	9.00	12.62	14.49	12.65	9.72	5.73	6.96	14.10	6.1	6.18
ON-ROUTE PRODUCTIVITY												
Services/Crew/On Route Hour		107.3	55.7	107.0	123.3	104.5	62.7	84.2	138.4	200.5	72.1	44.4
Tons/Crew/On Route Hour		2.5	2.0	2.6	3.1	3.3	2.0	1.2	1.7	3.3	1.2	1.1
Services/Crewman/On Route Hour		107.3	55.7	53.4	57.7	34.9	20.9	84.2	66.6	66.5	35.3	22.2
Tons/Crewman/On Route Hour		2.5	2.0	1.3	1.5	1.1	0.7	1.2	0.8	1.1	0.6	0.6
COST EFFICIENCY												
On Route Cost/Home/Week		0.13	0.20	0.16	0.15	0.30	0.36	0.29	0.37	0.34	0.27	0.37
Total Cost/Home/Week		0.19	0.30	0.23	0.22	0.39	0.55	0.37	0.51	0.48	0.32	0.47
On-Route Cost/Home/Year		6.76	10.40	8.32	7.80	15.60	18.72	15.08	19.24	17.68	14.04	19.24
Total Cost/Home/Year		9.88	15.60	11.96	11.44	20.28	28.60	19.24	26.52	24.96	16.64	24.44
On Route Cost/Ton		5.42	5.75	6.54	6.09	9.71	11.07	10.42	15.40	10.26	15.74	14.67
Total Cost/Ton		8.29	8.46	9.53	8.72	12.82	17.13	13.48	21.15	14.67	19.26	18.41
Indices of On Route Cost Per Home*		1.00	0.65	0.81	0.87	0.43	0.36	0.45	0.35	0.38	0.48	0.35
Indices of On Route Cost/Ton*		1.00	0.94	0.83	0.89	0.56	0.49	0.52	0.35	0.53	0.34	0.37

*Indices based on corresponding costs for System 1.

on-route hour and tons per on-route hour.

The last section provides the cost efficiencies associated with the various systems. Cost information based on the on-route phase of operations and also on the total operations is provided. The last two lines of this section provide indices of on-route cost per home and on-route cost per ton.

Table 18 provides additional productivity and efficiency indices. In each case the performance of System 1 is used as the basis for determining the index. Since all systems are compared with System 1, they may also be compared with each other.

The bar graphs of Figures 19 through 24 show graphically the relationship among the systems for homes served per crew and per crewman per collection hour, the tons collected per crew and per crewman per collection hour, and the collection cost per home per week and per ton collected.

Detailed Analysis of Systems Under Study

In this section, data are grouped to facilitate an analysis of the information gathered in the study effort. First, an analysis is made of the individual parameters that were used to define the systems in Table 1. Then, an overall analysis of system productivity, efficiency, and costs is made. These analyses are based on both DAAP and time motion study results. The method of analysis depends on the parameter being considered and the information that is available. Comparisons are made directly from the data or by using statistical or other procedures, including the results of regression analysis, where appropriate. Insofar as possible, DAAP and time motion data are presented and compared together under the same topical heading. All of the parameters under consideration are interrelated to some degree; hence, it

Table 18
PRODUCTIVITY AND EFFICIENCY INDICES

			PRODUCTIVITY INDEX								COLLECTION COST EFFICIENCY INDEX			
SYSTEM NUMBER	POUNDS PER SERVICE PER DAY	TOTAL SERVICES PER DAY	SERVICES PER CREW MAN PER COLL. HOUR	INDEX	SERVICES PER CREW PER COLL. HOUR	INDEX	TONS PER CREW MAN PER COLL. HOUR	INDEX	TONS PER CREW PER COLL. HOUR	INDEX	COST PER SERVICE PER WEEK	INDEX	COST PER TON	INDEX
1	46.2	410	107.3	1.00	107.3	1.00	2.5	1.00	2.5	1.00	.13	1.00	5.42	1.00
2	71.0	254	55.7	.52	55.7	.52	2.0	.80	2.0	.80	.20	.65	5.75	.94
3	28.2	410	84.2	.78	84.2	.78	1.2	.48	1.2	.48	.29	.45	10.42	.52
4	49.3	512	53.4	.50	107.0	1.00	1.3	.52	2.6	1.04	.16	.81	6.54	.83
5	50.5	575	57.7	.54	123.3	1.15	1.5	.60	3.1	1.24	.15	.87	6.09	.89
6	24.4	574	66.6	.62	138.4	1.29	.8	.32	1.7	.68	.37	.35	15.40	.35
7	62.2	407	34.9	.33	104.5	.97	1.1	.44	3.3	1.32	.30	.43	9.71	.56
8	64.9	306	20.9	.19	62.7	.58	.7	.28	2.0	.80	.36	.36	11.07	.49
9	33.1	854	66.5	.62	200.5	1.87	1.1	.44	3.3	1.32	.34	.38	10.26	.53
10	33.9	364	35.3	.33	72.1	.67	.6	.24	1.2	.48	.27	.48	15.74	.34
11	51.1	243	22.1	.21	44.4	.41	.6	.24	1.1	.44	.37	.35	14.02	.37

FIGURE 19
Homes Served Per Crew Per
Collection Hour

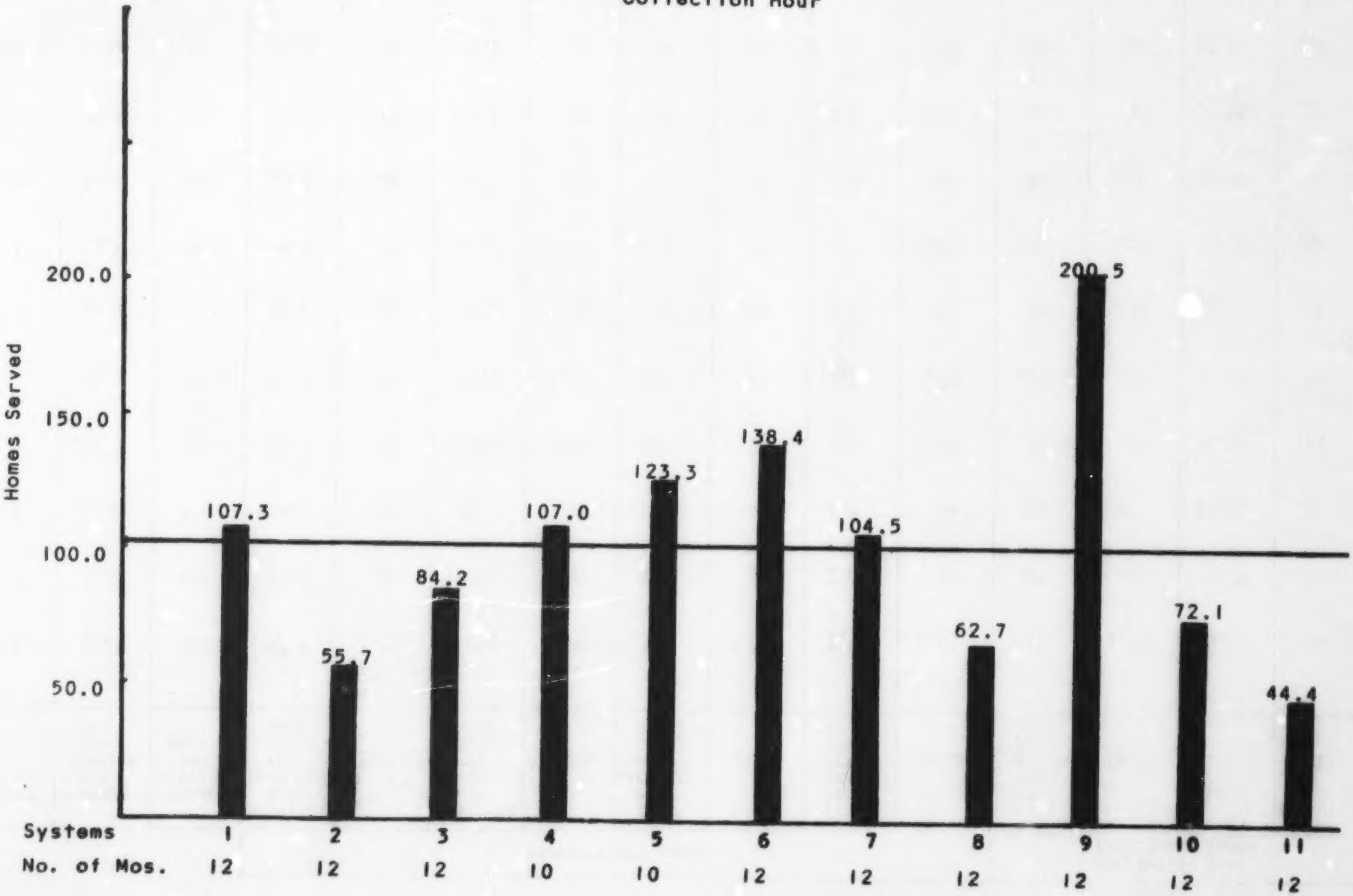


FIGURE 20
Homes Served Per Crewman
Per Collection Hour

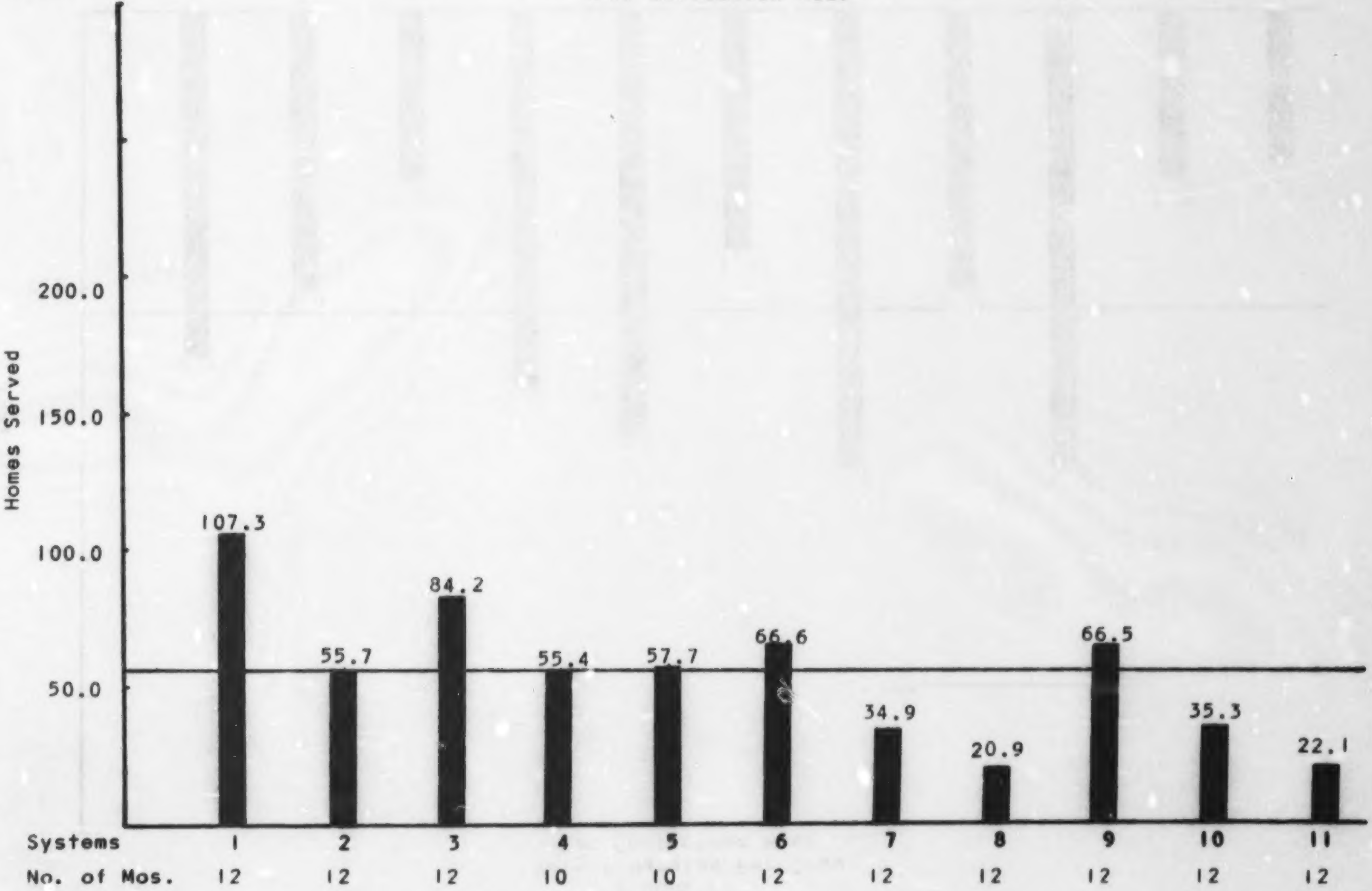


FIGURE 21
Weight Handled Per Crew
Per Collection Hour

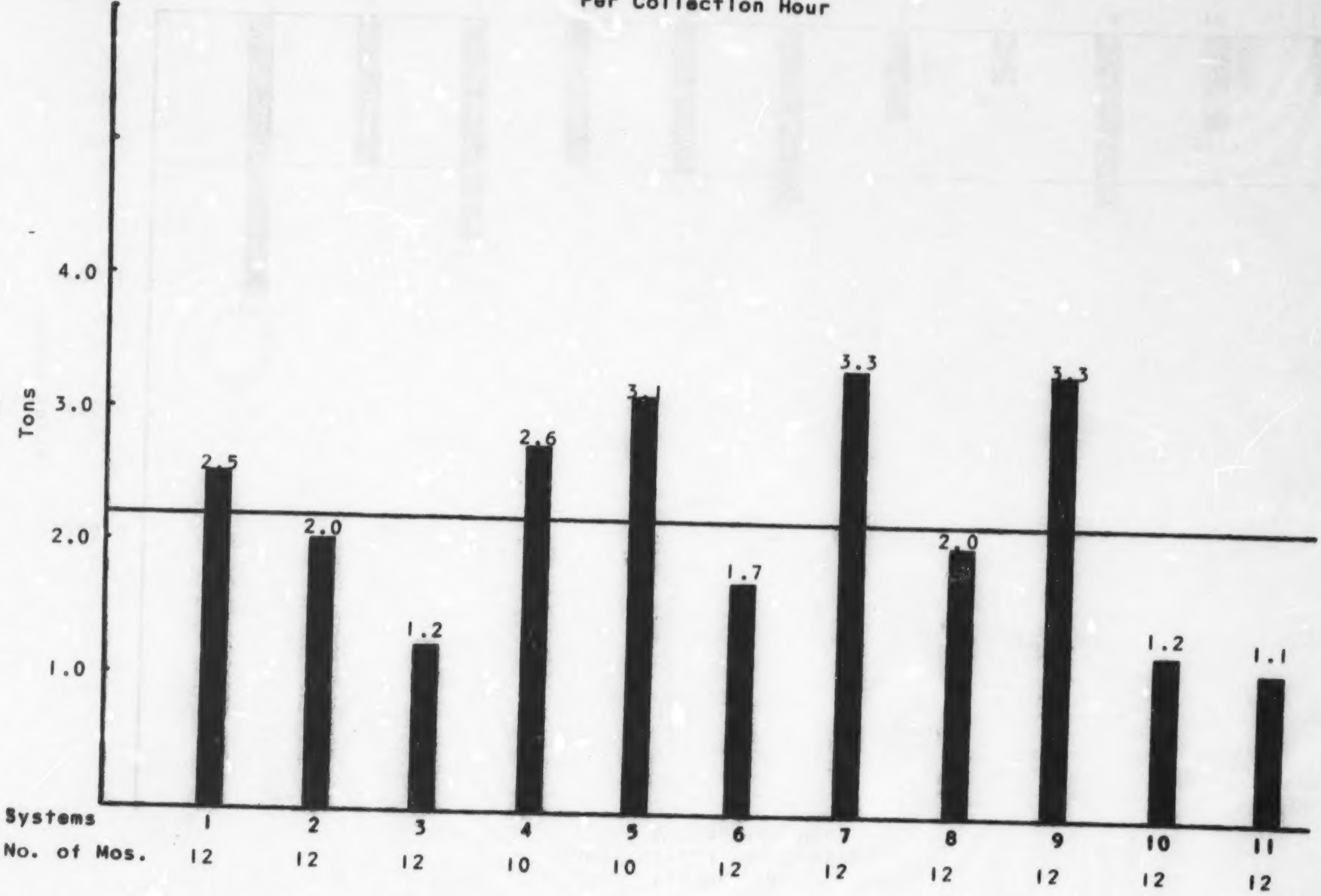


FIGURE 22
Weight Handled Per Crewman
Per Collection Hour

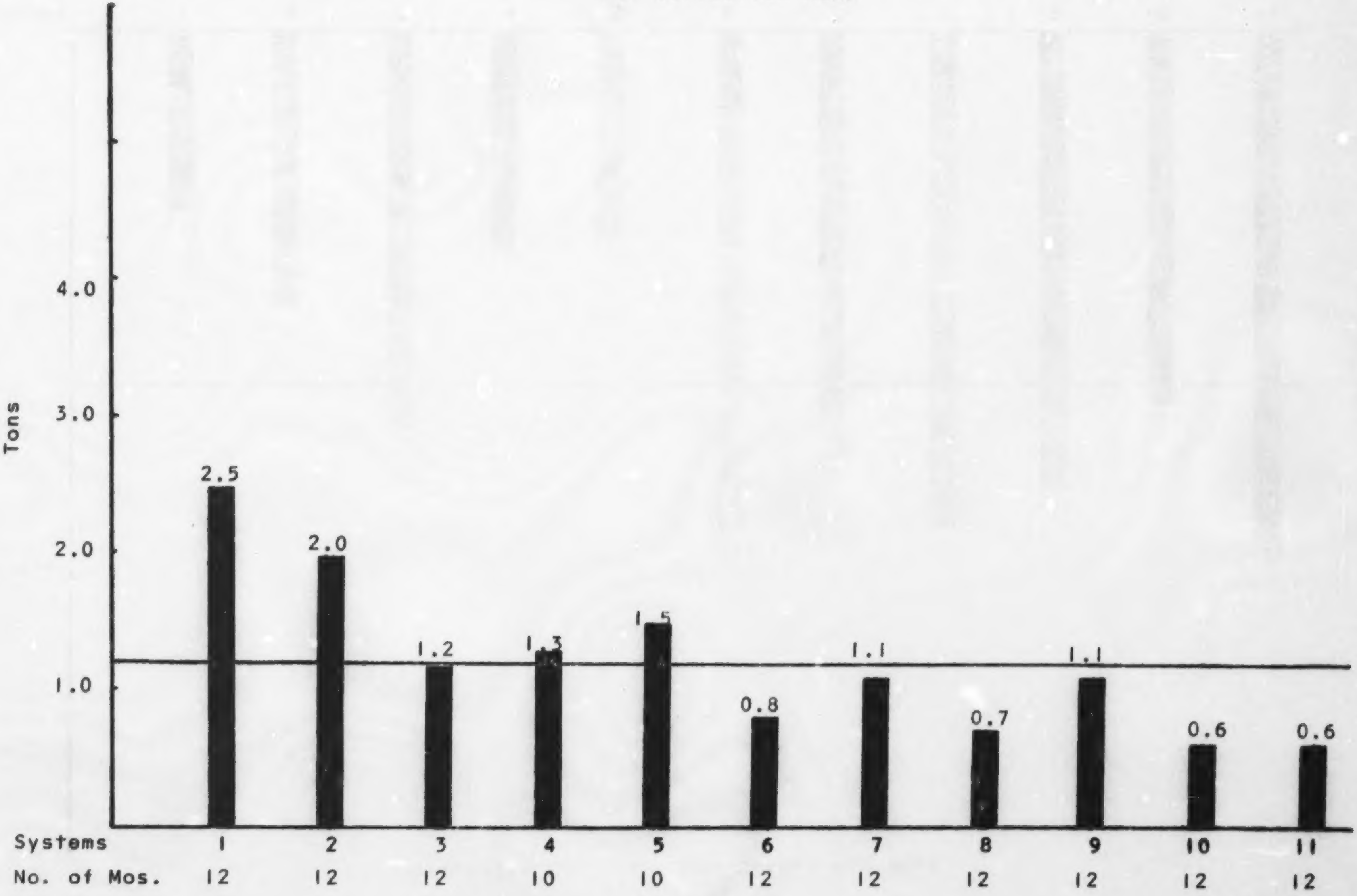


FIGURE 23
Collection Cost Per Home Served Per Week

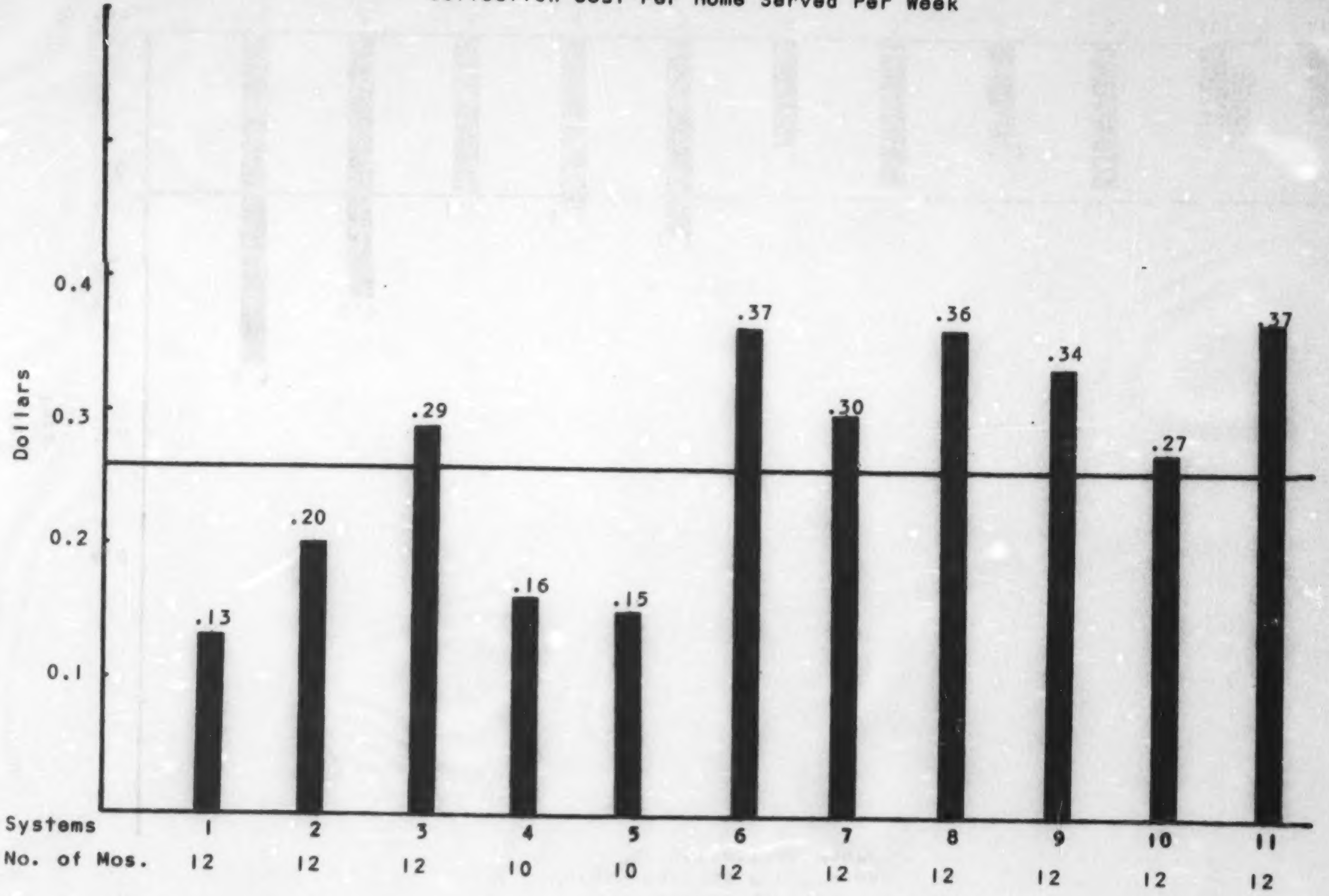
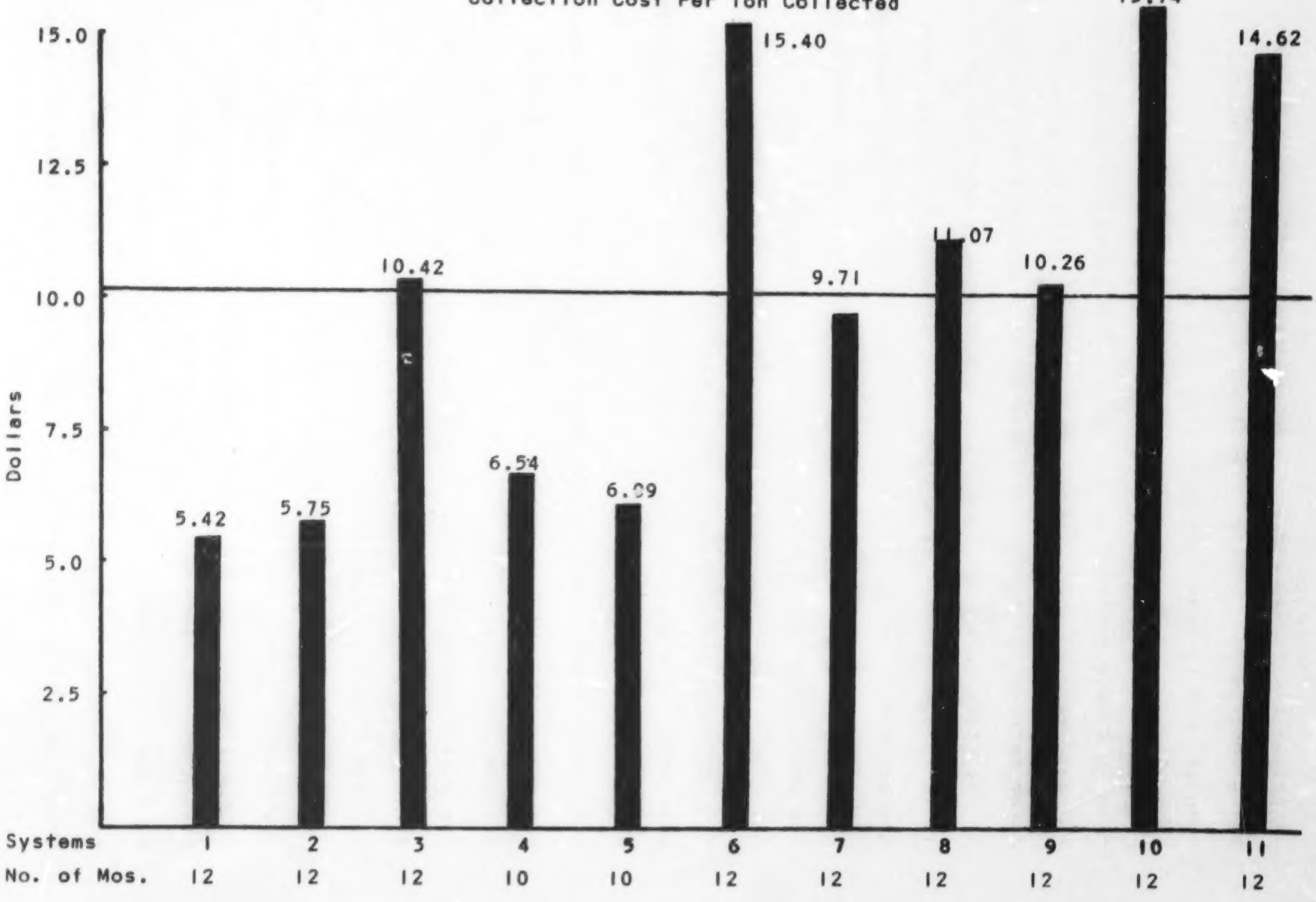


FIGURE 24
Collection Cost Per Ton Collected



is impossible to isolate the independent effect of each factor being considered. General trends and significant conclusions, however, can be made from an analysis of each item.

In making the following analyses occasional reference will be made to simple averages of averages. This procedure is used only to indicate trends and general information. This approach is taken because the numbers of items being considered and the values of the items being considered are of the same general magnitude. It is recognized that in the strictest mathematical terms, this procedure will not provide rigorous results and weighted averages should be used; however, the procedures used will not invalidate the analyses or the conclusions reached in the analyses.

Performance Analysis by Type of Equipment

General. Systems 1, 2, and 3 used side loading collection equipment. The vehicle may be loaded and driven from either side. A picture of this equipment is provided in Figure 25. This side loading collection vehicle was designed to be operated by a one-man crew. It is a light compaction vehicle and is designed to achieve densities in the range of 500 to 550 pounds per cubic yard. The packer can be operated by the main vehicle engine or by an auxiliary engine. The vehicle is available in four sizes: 25, 29, 33, and 37 cubic yards.

System 6 used side loading collection equipment with a detachable eight cubic yard container. The vehicle may be loaded and driven from either side. A picture of this equipment is provided by Figure 26. The detachable container system was designed to be operated by a one-man or two-man crew. It is a light compaction vehicle and is designed to achieve densities in the range of 500 to 600 pounds per cubic yard. The equipment uses a detachable container of eight cubic yards. When full, this container is replaced with an empty one. The full containers are emptied by an auxiliary front loading vehicle, the mother truck.

All other systems used the conventional rear loading equipment. A picture of a typical rear loading packer is provided by Figure 27. The rear loading equipment was designed for operation with a crew size of two or more. The rear loading equipment may be either medium duty or heavy duty from a compaction standpoint. The medium duty equipment is designed to achieve densities in the range of 700 to 750 pounds per cubic yard. The heavy duty equipment is designed to achieve densities in the range of 900 to 1,000 pounds per cubic yard. Rear loading equipment is available in many sizes, ranging generally from 10 to 25 cubic yards.

A summary of the significant equipment performance data obtained during the study is provided by Table 19. For the purposes of this study, the first loads were assumed to be "full" loads in terms of the operating performance of each system.

The information of Table 19 is structured to show the difference between the equipment performance being achieved in actual practice in comparison with the minimum performance that can reasonably be expected from the equipment. While there were differences in the age of the equipment being used in this study, all of the equipment was sufficiently new to be able to achieve the minimum compaction densities established in the table. The last column of the table provides the ratio of the performance being achieved by each system to the minimum performance that can be expected from the equipment.

Facts. The following facts are readily apparent from the information of the table.

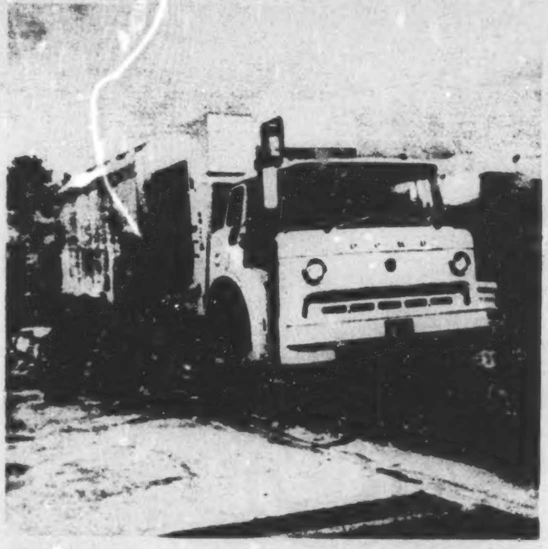


Figure 25
Side Loading
Collection
Vehicle

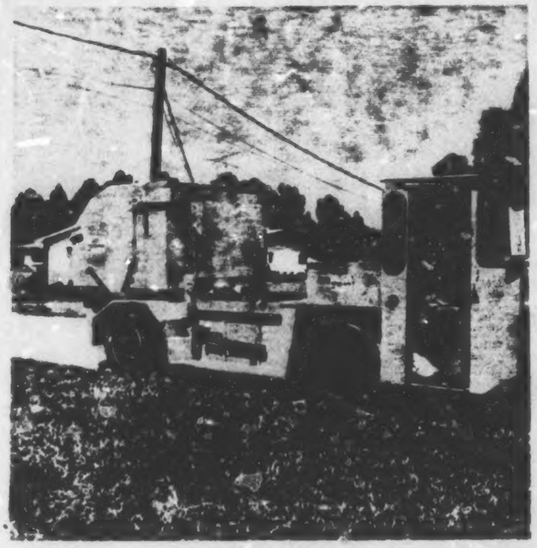


Figure 26
Side Loading Collection
Vehicle with Detachable
eight cubic yard container

Figure 27
A Typical Rear Loader

TABLE 19

EQUIPMENT PERFORMANCE DATA

STUDY RESULTS									EXPECTED RESULTS		
					AVERAGE WEIGHT						
SYSTEM NUMBER	TYPE EQUIPMENT	AVERAGE SIZE (CU YD)	AVERAGE LOADS PER DAY	AVERAGE WEIGHT PER DAY (TONS)	FIRST LOAD (TONS)	ALL OTHERS (TONS)	RATIO ALL OTHERS TO FIRST LOAD	WEIGHT PER CUBIC YARD FIRST LOAD (POUNDS)	MINIMUM[1] EXPECTED WEIGHT PER CUBIC YARD (POUNDS)	MINIMUM[2] EXPECTED WEIGHT PER LOAD (TONS)	RATIO[3] FIRST LOAD TO MINIMUM EXPECTED WEIGHT PER LOAD
1	SL	25.0	1.8	9.44	6.43	3.95	0.61	515	500	6.25	1.03
2	SL	25.0	1.6	9.00	5.93	4.90	0.83	474	500	6.25	0.95
3	SL	33.0	1.0	5.73	5.69	3.41	0.60	345	500	8.25	0.69
4	RL	20.0	2.4	12.62	5.92	4.92	0.83	593	700	7.00	0.85
5	RL	24.2	1.9	14.49	9.02	5.85	0.65	744	900	10.89	0.83
6	DC	8.0	4.4	6.96	1.56	1.58	1.00	390	500	2.00	0.78
7	RL	20.0	2.2	12.65	6.61	4.89	0.74	662	700	7.00	0.94
8	RL	23.0	1.6	9.72	5.98	6.84	1.14	525	700	8.05	0.74
9	RL	20.0	2.3	14.10	6.93	5.35	0.77	693	700	7.00	0.99
10	RL	20.0	1.0	6.18	6.14	2.38	0.39	614	700	7.00	0.88
11	RL	15.0	1.9	6.18	3.86	2.60	0.67	522	700	5.25	0.74

NOTES:

1. Assumed densities based on expected performance by manufacturers of equipment.
   Normal densities for the side loading vehicle should range from 500 to 550 pounds per cubic yard.
   Normal densities for medium duty rear loading packing equipment should range from 700 to 750 pounds per cubic yard.
   Normal densities for the detachable container should range from 500 to 600 pounds per cubic yard.
   Normal densities for heavy duty rear loading packing equipment should range from 900 to 1,000 pounds per cubic yard.
2. Expected minimum load based on the minimum densities of Note 1 and average size (cubic yards) of the system vehicles.
3. Ratio of the system first load weight which is assumed to be a "full" load, and the minimum expected weight per load.

Only two systems (Systems 3 and 10) averaged only one load per day with the equipment that was being used. Most systems averaged more than one load per day.

There was a wide range of tons collected per day. The least was System 3 with 5.79 tons per day. The most was System 5 with 14.49 tons per day.

For the equipments being used, there was a wide range in the densities being achieved with "full" loads and a corresponding wide range in the weights of the first loads for the equipments being used. This wide range of weights for the full loads was also reflected in a wide range in the ratios of the weights achieved for full loads to the minimum expected weight for a full load (last column of the table). Only one system (System 1) met the minimum performance standards for the kind of equipment being used. Only three additional systems equaled or bettered 90 percent of the minimum standard. System 3 achieved only 69 percent of the minimum standard. System 3, using the 33 cubic yard side loading vehicle,actually collected less waste in its one load than the first loads of Systems 1 and 2, which were using same vehicle in the 25 cubic yard size. With the rear loading equipment, System 8, with an average vehicle size of 23 cubic yards, collected less waste in the first load than Systems 7, 8, and 10 which were using vehicles of 20 cubic yards.

In comparison with the weight collected on the first load, there was a wide range of weights collected in the subsequent loads. The first load to subsequent load ratio ranged from 0.39 for System 10 to 1.14 for System 8. Only System 8 averaged more weight in the subsequent loads than it did on the first load. The weight of all detachable containers was essentially the same.

Figure 2E
Average Weight Per Load
(1st load, others)

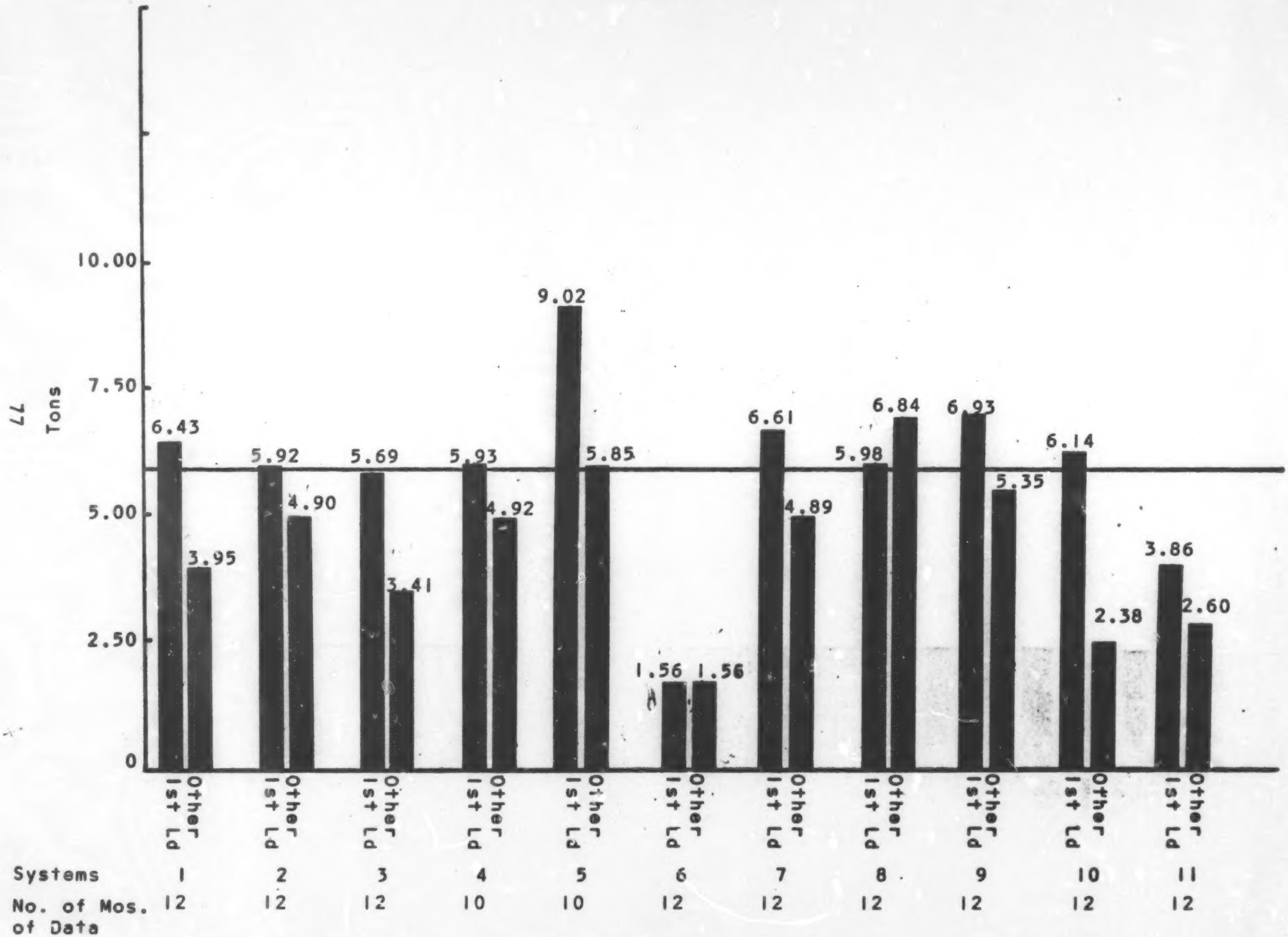


Figure 28 shows graphically the relationship between the first load and all subsequent loads by system.

Discussion. Many factors influence the selection of collection equipment. Some of these factors include the size of the crew, the number of homes to be served, the waste generation rates, the type of waste being collected, the time spent in collecting waste, the distance to the disposal point and relative costs of the equipment.

In considering compaction collection vehicles the user has the choice of front loading, side loading, or rear loading equipment. The user can also select light duty, medium duty, or heavy duty compacting equipment. In general, the light duty equipment will achieve densities from 500 to 600 pounds per cubic yard. Medium duty equipment will achieve densities from 700 to 750 pounds per cubic yard and heavy duty equipment will achieve densities from 900 to 1,000 pounds per cubic yard. Within each of these categories a wide range of sizes is available.

In selecting his equipment the user should match the equipment specifications (size, type, and compacting performance) with the characteristics of his operation (crew size, weight to be collected, collection time and distance to the disposal point) such that full loads are collected, insofar as possible. Full loads in this context means achieving the minimum compaction density for the class of equipment being used or considered. Collecting full loads maximizes the proportion of time being spent in the collection phase of the operation by minimizing the transport time and number of loads and provides maximum cost effectiveness in the utilization of the collection equipment. For an efficient operation the least possible time should be spent in traveling to the route and in traveling to and from the disposal point.

The decision to select a specific kind and size of collection equipment should not be taken lightly by the solid waste collection manager. The most important reason is that the equipment selected represents a considerable capital investment that will be used for several years. During the period of use there is little that can be done to change a bad decision because in most cases the equipment is used until it is worn out. This period is generally five years but may be ten years or longer. Since most packers tend to be competitive in cost, price should not be a primary consideration in selecting equipment.

Several methods can be used to determine the size of vehicle that is required for the collection operations. The best method is to match the equipment specifications with the expected operational performance. In this case the kind and size of vehicle is determined from a rational analysis of the factors that effect the collection activities. The significant factors would include crew size, the annual generation rates, the time available for collecting, and the performance standards expected from the crews. With this information the trade-offs between the kinds of vehicles and then sizes can be analyzed to provide the most cost-effective solution for the operation.

An alternate method is deciding on a general purpose vehicle, such as medium duty packer of 20 cubic yards, and then build the route activities around this vehicle. This is the method that is probably used most often; however, with this method there tends to be a significant imbalance between the capabilities of the vehicle and the characteristics of the route and capability of the crews. This leads to the underutilization of vehicles that is indicated in Table 19.

A third method is to use a mathematical model. Two regression models are provided in Annex E of Volume III. Enclosure 3 provides a model for loads per day as a function of vehicle size, pounds per service per collection and services per day. Enclosure 4 provides a model for services per load as a function of vehicle size, pounds per cubic yard, and pounds per service per collection. With these equations the solid waste manager can plan for the proper equipment for his operation. In using these models, however, it is important to realize that these equations were based on the performance of the study systems. This performance may not be applicable to the planned operation.

The difference between the minimum compaction density and maximum compaction density constitutes a reserve that can be used to handle peak generation rates or to permit growth in the route structure. This reserve is of the nature of 50 pounds per cubic yard for the light and medium duty equipment and 100 pounds per cubic yard for heavy duty equipment.

In only one system the weight of the subsequent loads exceeded the weight of the first load. This condition indicates the time at which collection ends for the first load is being dictated by considerations other than having a full load. Even though the subsequent loads were heavier than the first loads, they were still significantly less (0.85) than the minimum expected weight for a full load.

The significance of equipment costs will be considered later in this section under the heading of Cost Analysis.

Conclusions. The following conclusions resulted from a consideration of the equipment used in the study.

There is a strong tendency to underutilize the equipment from a compaction standpoint. Only one system out of eleven (9 percent) was routinely achieving a reasonable minimum weight for "full" loads for the equipment being used. The majority of the systems (91 percent) were underutilizing the equipment in terms of the weight achieved for "full" loads.

Only two systems out of eleven (18 percent) averaged only one load per day, and both of these underutilized their equipment capacities. All other systems (82 percent) averaged more than one load per day.

In only two systems (18 percent) were the subsequent loads equal to or greater than the first or "full" loads. In all cases the weight of the subsequent loads was significantly less than the minimum weight expected for "full" loads. This indicates the equipment was underutilized for subsequent loads. This procedure results in relatively more time being spent in transporting and relatively less time being spent in collecting than there should be in a system in which the vehicle characteristics are matched with the route and crew characteristics.

Performance Analysis by Crew Size

General. In this analysis only the curb and alley systems are considered. Both backyard systems used a crew of two men. The curb and alley systems used crew sizes of one, two, and three men. While there were significant differences in the operation of the nine curb and alley systems, the analytical approach provides a general indication of what can be expected from crews of various sizes. Data are examined from the standpoint of the whole crew and also from the standpoint of the individual crewman.

A summary of the significant crew performance data for curb and alley systems is provided by Table 20. This table was structured to show the productivity of the various systems in terms of homes served and tons collected. Information is provided both for the crew and for the individual crewman.

A summary of crew productive time for curb and alley systems is provided by Table 21. Information for this table was extracted from the DAAP and the time motion reports.

The marginal productivity of the crews and individual crewmen for curb and alley systems is provided by Table 22. In this table, four sets of data are shown. In the first section of the table, system averages by size of crew are indicated. Each number for each crew size represents eight once-a-week and four twice-a-week crews. In the second portion of the table, information for those systems that collect once weekly was averaged by size of crew. In the third section of the table, information for those systems that collect twice weekly is provided. In the last section of the table, the best single parameter for each crew size was used regardless of the frequency of collection.

Ranges of crew and crewman productivity are provided by Table 23.

Facts. From Table 20, the following facts are readily apparent.

There is a wide range in the number of homes served per crew per day. The least is 254 for System 2, and the most is 854 for System 9. There is also a wide range in the tons collected per day. The least is 5.73 tons for System 3, and the most is 14.49 tons for System 5.

Table 20

CREW PERFORMANCE DATA (CURB AND ALLEY SYSTEMS)

SYSTEM NUMBER	CREW DATA					CREWMAN DATA			
	CREW SIZE	HOMES SERVED PER CREW PER DAY	HOMES SERVED PER CREW PER COLLECTION HOUR*	TONS COLLECTED PER CREW PER DAY	TONS COLLECTED PER CREW PER COLLECTION HOUR	HOMES SERVED PER CREWMAN PER COLLECTION HOUR	INDEX	TONS COLLECTED PER CREWMAN PER COLLECTION HOUR	INDEX
1	1	410	107.3	9.44	2.5	107.3	1.00	2.5	1.00
2	1	254	55.7	9.00	2.0	55.7	0.52	2.0	0.80
3	1	410	84.2	5.73	1.2	84.2	0.78	1.2	0.48
4	2	512	107.0	12.62	2.6	53.4	0.50	1.3	0.52
5	2	575	123.3	14.49	3.1	57.7	0.54	1.5	0.60
6	2	574	138.4	6.96	1.7	66.6	0.62	0.8	0.32
7	3	407	104.5	12.65	3.3	34.9	0.33	1.1	0.44
8	3	306	62.7	9.72	2.0	20.9	0.19	0.7	0.28
9	3	854	200.5	14.10	3.3	66.5	0.62	1.1	0.44

*Collection hour = on-route time

Table 21

CREW PRODUCTIVE TIME (CURB AND ALLEY SYSTEMS)

System Number	Crew Size	ON-ROUTE ACTIVITIES				TOTAL ACTIVITIES		
		Relative Time On Route	Relative Productive Time	Percent Productive Time	Percent Non-Productive Time	Relative Total Time	Percent Productive Time	Percent Non-Productive Time
1	1	65.2	63.7	97.6	2.4	100.0	98.5	1.5
2	1	67.8	65.0	95.8	4.2	100.0	97.2	2.8
3.	1	77.4	75.0	96.8	3.2	100.0	97.6	2.4
4	2	68.5	47.3	69.0	31.0	100.0	63.0	37.0
5	2	69.8	43.2	61.8	38.2	100.0	58.3	41.7
6	2	72.8	55.9	76.7	23.3	100.0	69.5	30.5
7	3	75.8	53.3	70.3	29.7	100.0	61.3	38.7
8	3	64.6	46.9	72.6	27.4	100.0	58.7	41.3
9	3	70.0	51.0	72.8	27.2	100.0	61.0	39.0

Table 22

MARGINAL PRODUCTIVITY (CURB AND ALLEY SYSTEMS)

CREW SIZE	HOMES PER CREW PER HOUR	MARGINAL INCREASE IN PRODUCTIVITY HOMES PER CREW PER HOUR	TONS PER CREW PER HOUR	MARGINAL INCREASE IN PRODUCTIVITY TONS PER CREW PER HOUR	HOMES PER CREWMAN PER HOUR	MARGINAL DECREASE IN PRODUCTIVITY HOMES PER CREWMAN PER HOUR	TONS PER CREWMAN PER HOUR	MARGINAL DECREASE IN PRODUCTIVITY TONS PER CREWMAN PER HOUR
AVERAGE OF ALL SYSTEMS								
1 man	82.4	-----	1.9	---	82.4	----	1.9	---
2 man	122.9	40.5	2.5	0.6	59.9	22.5	1.2	0.7
3 man	122.6	(0.3)	2.9	0.4	40.8	19.1	1.0	0.2
AVERAGE OF ALL SYSTEMS COLLECTING ONLY ONCE A WEEK								
1 man	81.5	------	2.3	-----	81.5	----	2.3	---
2 man	115.2	33.7	2.9	0.6	56.6	24.9	1.4	0.9
3 man	83.6	(31.6)	2.7	(0.2)	27.9	28.7	0.9	0.5
AVERAGE OF ALL SYSTEMS COLLECTING TWICE A WEEK								
1 man	84.2	----	1.2	---	84.2	----	1.2	-----
2 man	138.4	54.2	1.7	0.5	66.6	17.6	0.8	0.4
3 man	200.5	62.1	3.3	1.6	66.5	0.1	1.1	(0.3)
MOST PRODUCTIVE PARAMETERS FROM ALL SYSTEMS								
1 man	107.3	----	2.5	---	107.3	----	2.5	---
2 man	138.4	31.1	3.1	0.6	66.6	40.7	1.5	1.0
3 man	200.5	62.1	3.3	0.2	66.5	0.1	1.1	0.4

Table 23

RANGES OF CREW AND CREWMAN PRODUCTIVITY (CURB AND ALLEY SYSTEMS)

System Number	CREW PRODUCTIVITY				CREWMAN PRODUCTIVITY			
	Homes Per Collection Hour*		Tons Per Collection Hour*		Homes Per Collection Hour*		Tons Per Collection Hour*	
	Range	Average	Range	Average	Range	Average	Range	Average
1	92.1-124.3	107.3	1.9-3.2	2.5	92.1-124.3	107.3	1.9-3.2	2.5
2	50.8-68.2	55.7	1.7-2.3	2.0	50.8-68.2	55.7	1.7-2.3	2.0
3	77.4-92.2	84.2	1.1-1.3	1.2	77.4-92.2	84.2	1.1-1.3	1.2
4	94.1-135.6	107.0	2.1-3.1	2.6	47.1-67.8	53.4	1.1-1.6	1.3
5	110.3-165.9	123.3	2.7-3.8	3.1	45.9-78.4	57.7	1.2-1.9	1.5
6	130.4-159.3	138.4	1.5-1.9	1.7	62.1-79.7	66.6	0.8-1.0	0.8
7	87.6-125.1	104.5	3.0-4.0	3.3	29.2-41.6	34.9	1.0-1.3	1.1
8	58.7-66.4	62.7	1.5-2.3	2.0	19.4-22.2	20.9	0.5-0.7	0.7
9	179.1-226.9	200.5	3.1-3.5	3.3	58.2-74.2	66.5	1.0-1.2	1.1

* Collection = On-Route

Likewise, when the data are considered on the crew productivity basis of homes served per collection hour and tons collected per collection hour, there is still considerable variation. The greatest crew productivity in terms of homes served per crew per collection hour is System 9 with a value of 200.5. The least productive crew is System 2 with 55.7 homes served per collection hour. The highest crew productivity on a tons per collection hour basis is 3.3. Two systems achieved this rate. They were Systems 7 and 9. System 5 also averaged over three tons per hour. The least productive crew was System 3 with only 1.2 tons per hour.

When the crew performance is considered on a crewman basis, there is a general downward trend in productivity as the size of the crew increases. System I is the most productive system by both measures and averaged 107.3 homes per crewman per collection hour and 2.5 tons per crewman per collection hour. The least productive system by both measures was System 8 with 20.9 homes homes per crewman and 0.7 tons per crewman per collection hour.

From Table 21, the following facts are readily apparent. The one-man crews show the greatest percentage of productive time on-route and for the total activities. For the one-man systems this averages 97.8 percent productive time for the total activities of the day.

The two- and three-man crews show a significant decrease in the percentage of productive time both on the route and for the total activities of the day. There is also little distinction between the two-man and three-man crews. The percentage of productive time for the two- and three-man crews on route was 69.2 and 71.9, respectively. For the total activities of the day the percentage of productive time for the two- and three-man crews was 63.6 and 60.3, respectively.

From Table 22, the following facts are readily apparent.

Regardless of the group of data considered the marginal productivity increase obtained by adding crew members is always less than the productivity of the one-man crew. That is, the productivity of the two-man crews is less than the productivity of two one-man crews. The same applies to the three-man crews. In some cases the marginal increase in productivity in going from two-man to three-man crews is negative.

When the marginal decrease in productivity is considered on a per crewman basis, the general trend is a marked decrease in productivity as the crew size increases from one to three.

From Table 23, the following facts are readily apparent.

For each system there was a wide range of productivity factors over the period of one year in both homes served per collection hour and tons collected per collection hour. This variation pertained to both the crew and crewman activities.

Discussion. Many factors influence the productivity of the collection crews and crewmen. Some of these factors include the point of collection, frequency of collection, routing, housing density, traffic and parked cars, collection methodology, width of the street, type of equipment being used, the expected work effort in the normal work day, the waste generation rates, the type of waste being collected, the nature of the storage container, general climate conditions, the kind of incentive system and the motivational aspects of the collection organization to include the relative pay scales. No attempt was made during this study to isolate the effect of the individual factors that influence the crew productivity. While there is considerable knowledge on the motivational aspects of many kinds of workers, there is very little information in the literature concerning the solid waste collector.

It is apparent that the one-man crew is significantly more productive than his counterpart in multi-man crews. One can speculate, based on motivational studies that have been conducted with other workers, that this is related to the degree of control the one-man crew exercises over his task. He has control over his time and physical movement. He establishes the pace at which he choses to work. He is not dependent upon the activities of other crew members. He also has complete control over his technical environment. He is generally freer from close direct supervision. These control aspects may give the one-man crews greater job satisfaction and, hence, result in greater productivity. In addition, the one-man crews generally receive more pay than members of larger crew sizes. This situation also probably contributes to the greater productivity of one-man crews.

The time motion data indicate that the one-man crews spend a significantly greater proportion of the on-route time in productive activities in comparison with the two- and three-man crews. The average on-route percentage of productive time for the one-man crews was 96.7 percent. The non-productive time was about equally divided between waiting and other time. The two- and three-man crews show a significant decrease in the proportion of productive time on-route. This percentage averaged 69.2 for the two-man crews and 71.9 for the three-man crews. The non-productive time with the two- and three-man crews was associated primarily with waiting. In these cases, one crew member is waiting on another crew member or the crew members are waiting on the compaction cycle.

The study addressed only the productive and non-productive times associated with the collection or on-route phase of the operations. For the two- and three-man crews, there was also a significant amount of non-productive time associated with the going to the route and transport phases of the operation. This non-productive effort is included under the total activities columns of Table 21. These columns indicate that the percentage of non-productive time for the total activities of the day averaged 36.4 for the two-man crews, and 39.7 for the three-man crews. These figures include the non-productive time associated with going to the route and transporting waste. Table 17 indicates that approximately 30 percent of the time for the curb and alley systems is spent in going to the route and in transporting waste. The one-man crews are completely effective in these phases. With the two-man crews, one man is non-productive. Therefore, one-half of the man-hours spent in these phases is non-productive. For the three-man crew, two men are non-productive and two-thirds of the man-hours spent in these phases is wasted effort.

Table 23 indicates there is a considerable range in the productivity factors for each system, both in terms of the crew performance and the crewman performance. Much of this variability is undoubtedly associated with the crew members pacing themselves to get the work done in a reasonable time. A review of the monthly DAAP data indicates that in periods of high generation the rate at which the weight is collected increases. Likewise, in periods of low generation the rate at which homes are served increases. The crews, through experience, probably adjust their working pace based on the route conditions as they perceive them early in the collection phase of the operation for any given day.

Conclusions. The following conclusions resulted from a consideration of the crew sizes that were studied.

The productivity per crewman in terms of homes served and tons collected per collection hour is greatest with the one-man crews. On the average, the productivity of one two-man crew is less than the productivity of two one-man crews. The same is true of three-man crews.

The percentage of on route productive collection time for one-man crews is significantly greater than the percentage of productive time for two- and three-man crews. For one-man crews the productive time is about 97 percent. For the two- and three-man crews the productive time is approximately 70 percent. There is no significant difference in the percentage of productive time between the two- and three-man crews.

In going to the route and in transporting the collected waste only the driver is productive. All other crewmen, whether they ride with the driver or not, are non-productive in these operational phases. With these phases consuming approximately 30 percent of the work day, then one-half and two-thirds of the man-hours of this effort are wasted for two- and three-man crews, respectively.

Performance Analysis by Frequency of Collection

General. In this analysis only the curb and alley systems are considered. Both backyard systems collected on a frequency of once a week. Six of the curb and alley systems collected once a week and three of the systems collected twice a week.

Of the six curb and alley systems that collected once a week two systems utilized a crew of one man, two utilized a crew of two men and two utilized a crew of three men. The three systems that collected twice a week consisted of one system with each crew size. A summary of the significant performance data by frequency of collection is provided by Table 24.

Facts. From Table 24, the following facts are readily apparent.

There is considerable variation in the generation rates in pounds per home per collection among the once a week collection systems (the highest is 1.5 times the lowest) and also among the twice a week collection systems (the highest is 1.4 times the lowest). While there is considerable variation in the generation rates, the average of the two groups of systems is essentially the same at approximately 57.3 pounds per home per week. With systems that collect twice a week one-half of this weight is collected on each collection day on the average.

The average number of homes served per week by the once a week collection systems was 2,053. The average number of homes served per week by the twice a week collection systems was 1,361. Therefore, the average number of homes served by the twice a week collection systems was approximately two-thirds the number of homes served by the once a week collection systems.

The productivity of the two groups of systems, as determined by the homes served per crew per collection hour, was greater with those systems that collected twice a week. The average of all systems that collected once a week was approximately 93 homes per collection hour. The average of all systems that collected twice a week was approximately 141 homes per collection

Table 24

FREQUENCY OF COLLECTION DATA

SYSTEM NUMBER	POUNDS PER HOME PER COLLECTION	POUNDS PER HOME PER WEEK	HOMES SERVED PER WEEK	HOMES SERVED PER COLLECTION HOUR	COLLECTION COST PER HOME PER COLLECTION	COLLECTION COST PER HOME PER WEEK	TONS COLLECTED PER COLLECTION HOUR	COLLECTION COST PER TON
COLLECTION ONCE A WEEK								
1	46.2	46.2	2,052	107.3	0.13	0.13	2.5	5.42
2	71.0	71.0	1,268	55.7	0.20	0.20	2.0	5.75
4	49.3	49.3	2,561	107.0	0.16	0.16	2.6	6.54
5	50.5	50.5	2,876	123.3	0.15	0.15	3.1	6.09
7	62.2	62.2	2,034	104.5	0.30	0.30	3.3	9.71
8	64.9	64.9	1,531	62.7	0.36	0.36	2.0	11.07
Averages	57.4	57.4	2,053	93.4	0.22	0.22	2.6	7.43
COLLECTION TWICE A WEEK								
3	28.2	56.3	1,231	84.2	0.15	0.29	1.2	10.42
6	24.4	48.8	1,147	138.4	0.19	0.37	1.7	15.40
9	33.1	66.1	1,707	200.5	0.17	0.34	3.3	10.26
Averages	28.6	57.1	1,361	141.0	0.17	0.33	2.1	12.02

hour. This ratio is also approximately two-thirds.

The productivity of the two groups of systems, as determined by the tons collected per collection hour, was greater with those systems that collected once a week. The average of all systems that collected once a week was approximately 2.6 tons per collection hour. The average of all systems that collected twice a week was approximately 2.1 tons per collection hour. In this case the weight collected per collection hour for the twice-a-week systems was approximately 80 percent of the value for the once-a-week systems.

There is an inverse relationship between collection costs and productivity. Where the homes served per collection hour is larger, the cost per home is less. Where the tons collected per collection hour is greater, the cost per ton is less.

Discussion. The collection frequency adopted by a governmental agency may be dictated by several factors. Probably the most important factors are those associated with the general climates and health conditions in the area. Also important is the level of service desired by the citizens and for which they are willing to pay. Collection twice a week is a higher level of service than collection once a week.

In comparison with service once a week, collection twice a week requires additional resources in terms of crews and equipment. It appears from the study data that the number of homes served per week by the twice-a-week systems was approximately two-thirds of the once-a-week systems. In this context the twice-a-week systems would require approximately 50 percent more crews and equipment than the once-a-week systems to serve the same number of homes. That is, to go from once-a-week to twice-a-week collection would require 50 percent more crews than are used in the once-a-week system. Conversely, to go from twice-a-week to once-a-week collection would require 33 percent fewer crews than are used on the twice-a-week system.

Twice-a-week collection has a greater impact on the number of homes served per collection hour than on the tons collected per collection hour when compared with the same productivity factors for the once-a-week collection. The twice-a-week system collected, on the average, approximately 50 percent more homes per collection hour than the once-a-week systems. This is undoubtedly related to the lesser weight collected each collection day and a correspondingly smaller number of containers present at each home. While the twice-a-week systems serve approximately 50 percent more homes per collection hour, the weight collected per collection hour was only 80 percent of the weight collected per hour by the once-a-week systems.

Conclusions. The following conclusions resulted from a consideration of the frequencies of collection that were studied.

Increasing the frequency of collection from once a week to twice a week required approximately 50 percent more crews and equipment than the once-a-week systems. The average number of homes served per week for the twice-a-week collection systems was approximately two-thirds the number for once-a-week collection systems. Conversely, to decrease the frequency of collection from twice a week to once a week requires approximately 33 percent fewer crews and equipment than the twice-a-week systems.

In terms of productivity factors the twice-a-week collection systems served approximately 50 percent more homes per collection hour than the once-a-week collection systems. The weight collected per collection hour, however, was only 80 percent of the weight collected per collection hour by the once-a-week collection systems.

Performance Analysis by Storage Point

General. Two storage point locations were prescribed for the study effort. These were curb and alley and backyard. No distinction was made between the curb and alley for study purposes. Of the systems studied only System 8 was basically an alley system. Systems 10 and 11 were backyard systems. All other systems were curb and alley systems with collection being made predominantly from the curb.

For the purposes of this analysis only the two-man crews will be considered. A summary of the significant performance data considered by storage point is provided by Table 25.

Facts. From Table 25, the following facts are readily apparent.

The average weight collected per home per day by the curb and alley systems was approximately 41.4 pounds. For the backyard systems the average was approximately 42.50 pounds. Essentially, the average weight per home was the same with both groups of systems.

The homes served per crew per collection hour by the curb and alley systems averaged approximately 123. The homes served per crew per collection hour for the backyard systems averaged approximately 58. Therefore, the curb and alley systems collected from approximately twice as many homes per collection hour compared with the backyard systems.

The tons collected per collection hour by the curb and alley systems averaged approximately 2.5. The tons collected per collection hour by the backyard systems averaged approximately 1.2.

Table 25

STORAGE POINT DATA

SYSTEM NUMBER	COLLECTION FREQUENCY	WEIGHT PER HOME PER COLLECTION (POUNDS)	COLLECTION TIME PER HOME PER COLLECTION (MIN)	SERVICES PER CREW PER COLLECTION HOUR	WEIGHT COLLECTED PER CREW PER COLLECTION HOUR
CURB AND ALLEY SYSTEMS - MAN CREW					
4	1	49.3	0.56	107.0	2.6
5	1	50.5	0.49	123.3	3.1
6	2	24.4	0.44	138.4	1.7
BACKYARD SYSTEMS - MAN CREW					
10	1	33.9	0.83	72.1	1.2
11	1	51.1	1.36	44.4	1.1

Therefore, the curb and alley systems collected approximately twice as many tons per hour as the backyard systems.

Discussion. Backyard collection is a higher level of service than curb and alley collection. This kind of service causes the least impact on the physical requirements of the citizens regarding the removal of solid waste. This level of service is also the most expensive as additional personnel and equipment resources are required in comparison with curb and alley systems for the same number of homes served per week.

It appears that the productivity of a backyard collection system is approximately one-half of a corresponding curb and alley system, based on the results of this study effort. The reason is that the time to service a home with backyard collection is on the order of twice the time required for curb and alley service.

Conclusions. The following conclusion resulted from a consideration of the storage point locations that were studied.

The productivity of a backyard system, in terms of homes served per collection hour and tons collected per collection hour, is approximately one-half the productivity of a corresponding curb and alley system.

Performance Analysis by Collection Methodology

Three collection methodologies were prescribed for the study effort depending on crew size and point of collection. They were: collection from one side of the street at a time for curbside collection, one- and two-man crews (Systems 1-6); collection from both sides of the street at a time for curbside collection, three-man crews (Systems 7-9); and use of the tote-barrel for backyard collection (Systems 10 and 11).

Both backyard systems used two-man crews. In each case, both the driver and collector drove and collected. Both sides of the street were collected at the same time.

These methodologies were selected because they had been shown to be very productive and afficient in previous EPA studies. For curbside collection it is generally impractical to collect from both sides of the street with one- and two-man crews. In some special cases it may be practical to collect from both sides with a two-man crew. Such a case would be collecting from both sides of an alley with a two-man crew using a side loading packer. In this case both crew members could collect simultaneously. This exception was not the case in this study.

With the three-man systems there is a practical choice between collecting from one side and collecting from both sides of the street at a time. Factors which influence this decision are the width of street, traffic flow, parked cars, and housing density. With wide streets, heavy traffic and high density housing it is generally safer and best to collect from one side of the street at a time to avoid traffic and street crossing delays. However, with narrow streets and little traffic, there is greater potential for waiting delays on the part of the crewmen in collecting only one side at a time.

Performance Analysis by Incentive System

General. Two incentive systems were investigated in the study effort. They were the task incentive system and the standard day system.

The task incentive system was used by seven of the eleven systems in the study. These systems were Systems 1, 3, 4, 6, 7, 9 and 10. Four of the systems used the standard day system.

These systems were Systems 2, 5, 8 and 11.

The task incentive system is one in which a work effort is prescribed for the crew. When this work effort is completed to the satisfaction of the appropriate supervisor the crew is dismissed. With the task incentive system compensation is not generally paid to the crew for overtime work unless the reason for overtime was clearly not the fault of the crew. For the purposes of this study overtime was not considered for the systems which operated under the task incentive system.

The standard day system is one in which a work effort is prescribed for the crew, but regardless of how early the task is completed the crew is required to work the full standard day. The standard day for the four systems in this study was eight hours. Thus, the crews were obligated to perform additional work if they completed the collection effort in less than the standard day. In addition, compensation at the rate of 1.5 times the regular pay was made for all overtime worked in this study.

In the scheme of systems studied in this effort there was one task incentive system and one standard day system for each crew size in the curb and alley once-a-week systems. One of the backyard systems used the task incentive system and the other used the standard day system. A summary of the significant incentive system performance data for the different collection systems is provided by Tables 26 and 27.

Facts. From Table 26, the following facts are readily apparent.

All comparable task and standard day systems were on a 40 hour planned week. The average percentage of the planned work week that was worked was generally less for the task incentive

Table 26

INCENTIVE SYSTEM PERFORMANCE DATA - COMPARISONS BY INCENTIVE SYSTEMS

SYSTEM NUMBER	INCENTIVE SYSTEM	PLANNED WORK WEEK (HOURS)	HOURS WORKED PER WEEK	PERCENT OF WEEK WORKED	TOTAL ANNUAL OVERTIME COST PER CREW	DAAP COLLECTION TIME PER HOME (MIN)	TIME MOTION PRODUCTIVE TIME PER HOME (MIN)	DAAP TIME PER HOME TO TIME MOTION PRODUCTIVE TIME PER HOME
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 1 MAN CREW								
1	Task	40	29.62	74.1	--------	0.56	0.58	0.97
2	Standard Day	40	33.74	84.4	107.81	1.08	0.83	1.30
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 2 MAN CREW								
4	Task	40	35.64	89.1	--------	0.56	0.43	1.30
5	Standard Day	40	35.17	87.9	1,492.12	0.49	0.35	1.40
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 3 MAN CREW								
7	Task	40	26.03	65.1	--------	0.58	0.53	1.09
8	Standard Day	40	39.22	98.1	2,804.32	0.98	0.72	1.36
BACKYARD - COLLECTION ONCE WEEKLY - 2 MAN CREW								
10	Task	40	31.32	78.3	--------	0.83	----	----
11	Standard Day	40	34.75	86.9	62.85	1.36	----	----
Averages	Task	40	30.65	76.6	--------	0.63	0.51	1.12
	Standard Day	40	35.72	89.3	1,116.78	0.98	0.63	1.35

Table 27

INCENTIVE SYSTEM PERFORMANCE DATA - COMPARISONS BY PRODUCTIVITY MEASURES

SYSTEM NUMBER	INCENTIVE SYSTEM	HOMES SERVED PER DAY	TONS COLLECTED PER DAY	HOMES SERVED PER CREW PER COLLECTION HOUR	TONS COLLECTED PER CREW PER COLLECTION HOUR
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 1 MAN CREW					
1	Task	410	9.44	107.3	2.5
2	Standard Day	254	9.00	55.7	2.0
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 2 MAN CREW					
4	Task	512	12.62	107.0	2.6
5	Standard Day	575	14.49	123.3	3.1
CURB AND ALLEY - COLLECTION ONCE WEEKLY - 3 MAN CREW					
7	Task	407	12.65	104.5	3.3
8	Standard Day	306	9.72	62.7	2.0
BACKYARD - COLLECTION ONCE WEEKLY - 2 MAN CREW					
10	Task	364	6.18	72.1	1.2
11	Standard Day	243	6.18	44.4	1.1
Averages	Task	423	10.22	97.7	2.4
	Standard Day	344	9.85	71.5	2.0

systems than for the standard day systems. The average percentage of the planned week that was worked by the task incentive systems was approximately 77 percent. For the standard day systems this percentage was approximately 89 percent.

All systems operating under the standard day system received some overtime pay. The overtime pay indicated by the DAAP print-outs was a conservative figure because overtime for the preparation time associated with the daily activities was not included. Depending on the system this preparation time may account for up to one hour of paid time per day.

The average time required to service a home with the task incentive systems averaged approximately 0.63 minutes. This was significantly lower than the approximate average time of 0.98 minutes required by the standard day systems.

In comparing the time required to service a home from the DAAP reports with the productive time from the time motion studies, the task incentive systems show a closer correlation than the standard day systems. That is, the task systems have less non-productive time (waiting and other time) than the standard day systems. The average ratio for the task incentive systems was approximately 1.12. For the standard day systems this average was approximately 1.35.

From Table 27, the following facts are readily apparent.

In three out of the four groupings of data the task incentive systems equaled or significantly bettered the performance data of the standard day systems. In all production and productivity categories the averages for the task incentive systems are better than the averages for the standard day systems.

In only one case (curb and alley - collection once weekly -

two-man crew) did the standard day performance exceed the performance of the task incentive system.

Discussion. Only the task incentive and standard day systems were considered in this study. An exact proportion of systems that use the task incentive system in comparison with the standard day system is not available. It is generally believed that somewhat more than one-half of the systems are operating under the task incentive system.

The application of the standard day system takes many forms in actual practice. This ranges from a fully productive application such as is indicated by System 5 to a deliberate expansion of the work effort to consume the entire work day or to a diversion of personnel to other efforts after the collection activities have been completed.

It is generally acknowledged that the task incentive system is more productive in practice than the standard day system. Indeed, the results of this study indicate this in three direct comparisons of systems out of four. When the results of all of the task incentive systems are averaged and compared with the standard day systems, this is clearly the case in this study.

The task incentive system, however, is a good system only if the work effort which is expected to be accomplished in a normal work day bears some reasonable relationship to what should be accomplished in the normal work day. The data of Table 26 indicates that the portion of the normal work week that was spent on collection activities for the task incentive systems ranged from a low of 65.1 percent to a high of 89.1 percent. The average of these systems was approximately 76.6 percent. Each individual manager will have to appraise his own situation and decide what objective figure would be right for his organization. In most of the task incentive systems studied in this effort an additional planned one-half hour per day would have resulted in better utilization of the equipment and greater cost effectiveness in the operation even if a fair percentage of the savings were returned to the crews in the form of higher wages.

In considering the productivity of the standard day incentive systems there is a tendency for the task to expand to fill the day, and if not controlled, to go into overtime. Even with System 5, which was the one standard day system that out-performed the task incentive system, the DAAP collection time per home was 1.40 times the time motion productive time per home. This was the highest ratio among the standard day systems. Consequently, other factors must account for the high productivity of System 5. The high percentage of bags and one-way items undoubtedly has a favorable influence on this performance. The significance of the percentage of one-way items will be discussed in the next section.

In the case of systems using a one-man crew it would appear that the standard day system would be counter productive. If the higher productivity that is indicated by the one-man systems can be explained by current motivational concepts, then productivity must be associated with the high degree of control the crewman has over his work. In this context, it makes little sense to give the crewman this control so he can establish his work pace and, at the same time, require him to work a full standard day. The task incentive system should be used with all operations involving a crew of one man.

In general, it appears that the majority of the task incentive systems have a higher level of collection production and productivity than the standard day systems. This is true in an absolute sense, but, more importantly, the task incentive systems appear to be doing the work more efficiently. Stating this differently, the task incentive systems tend to do more work and do it more efficiently than the standard day systems.

Conclusions. The following conclusions resulted from a consideration of the incentive system data that were studied.

Collection systems operating under the task incentive system tend to work a smaller percentage of the normal work week than the standard day systems.

The work effort of standard day collection systems has a tendency to expand into overtime operations.

The collection production and productivity of the task incentive systems tend to be greater than the collection production and productivity of standard day systems.

Performance Analysis by Type of Storage Container

General. Bags and cans were prescribed as the storage containers for all of the systems that were studied. The relative quantities of bags, cans and miscellaneous items were determined from the time motion studies and backyard survey. The average of the values obtained from the four quarterly visits to each system was used in the DAAP summary reports.

Miscellaneous items are considered to be one-way items from a collection standpoint and are considered in the same category as bags. Miscellaneous items include things such as cardboard boxes of waste, bundles of paper, and bundles of small twigs and branches. One-way items need to be handled only once on the part of the collectors and, hence, should have a tendency to improve the productivity of the crews. On the other hand, poorly contained waste tends to slow the crews down. For purposes of analysis only the curb and alley systems will be considered.

A summary of the significant data pertaining to storage containers is provided by Table 28.

Facts. From Table 28, the following facts are readily apparent.

There was a considerable variation in the average number of containers that were serviced for each collection. The smallest average was 1.2 for System 10. The greatest average was 6.1 with System 7. The average for all systems was 4.1 containers.

There was also a wide range in the percentages of each kind of container that was used among the systems. The proportion of bags ranged from a low of 2 percent for System 10 to a high of 85 percent for System 5. The proportion of cans ranged from a low of 6 percent for System 5 to a high of 96 percent for System 10. The proportion of miscellaneous items ranged from a low of 2 percent for System 10 to a high of 28 percent for System 8.

There was a corresponding wide range in the percentages of one-way and two-way items.

No direct relationship between storage containers and productivity is readily apparent from the data of Table 26.

Discussion. System 10 averaged only 1.2 containers per service. This was the smallest average among the systems. In addition, 96 percent of the containers were cans. This was also the highest percentage of cans. System 10 requires all items to be placed in cans and charges for service on the basis of the number of cans served. These requirements tend to limit the

Table 28
STORAGE CONTAINER DATA

SYSTEM NUMBER	AVERAGE NUMBER OF CONTAINERS PER COLLECTION	AVERAGE NUMBER (AND PERCENT) OF STORAGE CONTAINERS			PERCENT		HOMES SERVED PER COLLECTION HOUR	DAAP COLLECTION TIME PER HOME (MIN)
		BAGS	CANS	MISC	ONE WAY ITEMS	TWO WAY ITEMS		
			CURB AND ALLEY SYSTEMS - BAGS AND CANS					
1	4.5	1.5 (34.0)	2.3 (52.0)	0.7 (14.0)	48.0	52.0	107.3	0.56
2	5.1	1.3 (26.0)	2.7 (53.0)	1.1 (21.0)	47.0	53.0	55.7	1.08
3	3.0	0.9 (29.0)	1.6 (53.0)	0.5 (18.0)	47.0	53.0	84.2	0.72
4	4.6	2.6 (56.0)	1.3 (28.0)	0.7 (16.0)	72.0	28.0	107.0	0.56
5	5.5	4.6 (85.0)	0.4 (6.0)	0.5 (9.0)	94.0	6.0	123.3	0.49
6	2.5	0.5 (19.0)	1.5 (61.0)	0.5 (20.0)	39.0	61.0	138.4	0.44
7	6.1	3.6 (56.0)	1.5 (28.0)	1.0 (16.0)	72.0	28.0	104.5	0.58
8	5.9	1.5 (25.0)	2.7 (47.0)	1.7 (28.0)	53.0	47.0	62.7	0.98
9	2.7	1.2 (46.0)	1.1 (41.0)	0.4 (13.0)	59.0	41.0	200.5	0.31
			BACKYARD SYSTEMS - TOTE-BARREL					
10	1.2	0.0 (2.0)	1.2 (96.0)	0.0 (2.0)	4.0	96.0	72.1	0.83
11	4.3	1.4 (33.0)	2.4 (55.0)	0.5 (12.0)	45.0	55.0	44.4	1.36

number of bags and miscellaneous items that are used in service. They also tend to limit the number of cans that residents use as storage containers.

System 7 averaged 6.1 containers per service. This was the largest average among the systems. A little over one-half of the containers were bags, but 72 percent of the containers were one-way items. This was the second highest percentage of one-way items.

System 5 had the highest percent of one-way items. Ninety-four percent of the items were one-way items, and 85 percent of the items were bags. The ordinance under which System 5 operates tends to generate a high percentage of bags even though these are provided by the residents. Cans are limited to 15 gallons capacity. Bags are limited to 30 gallons capacity. Although there is no limit on the number of items that can be placed on the curb, these requirements tend to limit the number of cans to a large degree.

Intuitively, it appears that the percentage of one-way items would have an important influence on the productivity of collection systems, especially for the curb and alley systems. To investigate this possibility the percent of one-way items was combined with other variables to determine the significance of the factors by regression analysis. Other variables included pounds per home per collection, homes per collection mile, number of storage containers per home, and crew size. Several regressions were made to determine an appropriate equation that could be used for predictive purposes and that would show the relative significance of the one-way items on productivity. In these analyses only the curb and alley systems were used (Systems 1 through 9). The data included equal numbers of one-, two-, and three-man crews and collection frequencies of once and twice weekly were distributed evenly among the crew sizes. All of the equations were of the form of

$$Y = aX_1 + bX_2 + cX_3 + dX_4 + e.$$

The following equations were used. The significant results are provided in Table 29.

Equation 1. Collection minutes per home as a function of percent one-way items and pounds per home per collection.

Where Y = collection minutes per home

X_1 = percent one-way items

X_2 = pounds per home per collection

Equation 2. Collection minutes per home as a function of percent one-way items, pounds per home per collection, and homes per collection mile.

Where Y = collection minutes per home

X_1 = percent one-way items

X_2 = pounds per home per collection

X_3 = homes per collection mile

Equation 3. Collection minutes per home as a function of percent one-way items, pounds per home per collection, and number of items per home.

Where Y = collection minutes per home

X_1 = percent one-way items

X_2 = pounds per home per collection

X_3 = number of items per home

Equation 4. Collection minutes per home as a function of percent one-way items, pounds per home per collection, number of items per home, and crew size.

TABLE 29

COLLECTION MINUTES PER HOME - REGRESSION ANALYSES

Equation	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
1	9	0.64	59.0	47.8	-----	----	-0.008	0.013	----	----	0.489	72.8
2	9	0.64	59.0	47.8	46.89	----	-0.008	0.013	NS*	----	0.489	72.8
3	9	0.64	59.0	47.8	4.43	----	-0.008	0.013	NS	----	0.489	72.8
4	9	0.64	59.0	47.8	4.43	2.0	NS	0.012	NS	NS	0.550	77.5

		Standard Deviation					Simple Correlation With Y			
1	9	0.25	17.4	16.6	-----	----	0.30	0.68	----	----
2	9	0.25	17.4	16.6	17.71	----	0.30	0.68	0.09	----
3	9	0.25	17.4	16.6	1.4	----	0.30	0.68	0.49	----
4	9	0.25	17.4	16.6	1.4	0.87	0.30	0.68	0.49	0.28

*NS = not significant

Where Y = collection minutes per home

X_1 = percent one-way items

X_2 = pounds per home per collection

X_3 = number of items per home

X_4 = crew size

The correlation data in Table 29 indicate that the pounds per home per collection (X_2) has the greatest influence on the collection minutes per home (Y) for each equation. Looking at the coefficients of the variables in the first three equations, only the percent one-way items and pounds per home per collection are significant. In the fourth equation only the pounds per home per collection is significant.

In considering the relationship that exists among the collection minutes per home, percent one-way items, and pounds per home per collection the following equation results.

$$Y = 0.489 - 0.008X_1 + 0.013X_2$$

This equation does indicate that the percent one-way items (X_1) does have a beneficial effect on crew productivity and tends to decrease the collection minutes per home (Y). The pounds per home per collection (X_2) has an adverse effect on productivity and tends to increase the time required to service a home. These conditions are in agreement with what we would expect in the field. The actual effect of a change in percentage of one-way items and pounds per home per collection depends on the magnitudes of these variables. For a 10 percent change in the average values of X_1 and X_2, as indicated in Table 29, the equation indicates that the pounds per home per collection has about 1.3 times the effect of percent one-way items and is in the opposite direction.

The information in Table 29 for Equation 4 indicates that only the weight per home per collection is significant. The resulting equation is

$$Y = 0.550 + 0.012X_2.$$

Where Y = collection minutes per home

X_2 = pounds per home per collection

The regression computer printouts for these equations are provided by Appendix 4.

Conclusions. The following conclusions resulted from a consideration of the type of storage containers.

The percentage of one-way items (bags and miscellaneous items) does have a significant effect on the system productivity. An increase in the percentage of one-way items reduces the time required to service a home, and conversely, increases the number of homes served per collection hour. A decrease in the percentage of one-way items increases the time required to service a home, and conversely, reduces the number of homes served per collection hour.

The weight per home per collection also effects the system productivity, and this effect is greater and opposite in direction to the effect of one-way items. An increase in weight per home increases the time required to service a home and decreases the number of homes served per collection hour. Conversely, a decrease in weight per home per collection reduces the time required to service a home and increases the number of homes served per collection hour.

Performance Analysis by Productivity and Efficiency

General. For the purpose of this analysis productivity will be considered in terms of homes served per collection hour and tons collected per collection hour. Productivity will be considered from the standpoint of the crew and the individual crewman. The productivity of each system will be compared with System I.

Efficiency for the purpose of this analysis will be considered in terms of the cost per service per week and the cost per ton. The efficiency of each system will be compared with System I.

Table 18 is provided again for a consideration of productivity and efficiency.

Systems are ranked according to their productivity in Table 30.

Systems are ranked according to their collection cost efficiency in Table 31.

Facts. From Tables 18 and 30, the following facts are readily apparent.

When productivity is considered on a per crewman basis for the curb and alley systems, there is a strong tendency for the smaller crew sizes to be more productive than the larger crew sizes.

There is a wide variation of crew productivity factors in both services per crew per collection hour and tons per crew per collection hour among all the systems.

Considering the curb and alley systems, the systems that have a collection frequency of twice a week have a tendency to serve a larger number of homes per collection hour than their once a week counterparts. The larger crew sizes have a tendency to collect more tons per collection hour than the smaller crew sizes.

When productivity is considered for the backyard systems, the greater productivity is with the system which uses the task incentive system (System 10).

Curb and alley systems tend to be more productive than

Table 18
PRODUCTIVITY AND EFFICIENCY INDICES

SYSTEM NUMBER	POUNDS PER SERVICE PER DAY	TOTAL SERVICES PER DDAY	PRODUCTIVITY INDEX								COLLECTION COST EFFICIENCY INDEX			
			SERVICES PER CREW MAN PER COLL. HOUR	INDEX	SERVICES PER CREW PER COLL. HOUR	INDEX	TONS PER CREW MAN PER COLL. HOUR	INDEX	TONS PER CREW PER COLL. HOUR	INDEX	COST PER SERVICE PER WEEK	INDEX	COST PER TON	INDEX
1	46.2	410	107.3	1.00	107.3	1.00	2.5	1.00	2.5	1.00	.13	1.00	5.42	1.00
2	71.0	254	55.7	.52	55.7	.52	2.0	.30	2.0	.80	.20	.65	5.75	.94
3	28.2	410	84.2	.78	84.2	.78	1.2	.48	1.2	.48	.29	.45	10.42	.52
4	49.3	512	53.4	.50	107.0	1.00	1.3	.52	2.6	1.04	.16	.31	6.54	.83
5	50.5	575	57.7	.54	123.3	1.15	1.5	.60	3.1	1.24	.15	.87	6.09	.89
6	24.4	574	66.6	.62	138.4	1.29	.8	.32	1.7	.68	.37	.35	15.40	.35
7	62.2	407	34.9	.33	104.5	.97	1.1	.44	3.3	1.32	.30	.43	9.71	.56
8	64.9	306	20.9	.19	62.7	.58	.7	.28	2.0	.80	.36	.36	11.07	.49
9	33.1	854	66.5	.62	200.5	1.87	1.1	.44	3.3	1.32	.34	.38	10.26	.53
10	33.9	364	35.3	.33	72.1	.67	.6	.24	1.2	.48	.27	.48	15.74	.34
11	51.1	243	22.1	.21	44.4	.41	.6	.24	1.1	.44	.37	.35	14.62	.37

Table 30

RANKING OF SYSTEMS BY PRODUCTIVITY

SERVICES PER CREWMAN PER HOUR				TONS PER CREWMAN PER HOUR				SERVICES PER CREW PER HOUR				TONS PER CREW PER HOUR			
SYSTEM	CREW SIZE	ACTUAL	INDEX	SYSTEM	CREW SIZE	ACTUAL	INDEX	SYSTEM	CREW SIZE	ACTUAL	INDEX	SYSTEM	CREW SIZE	ACTUAL	INDEX
							CURB AND ALLEY SYSTEMS								
1	1	107.3	1.00	1	1	2.5	1.00	9*	3	200.5	1.87	9*	3	3.3	1.32
3*	1	84.2	0.78	2	1	2.0	0.80	6*	2	138.4	1.29	7	3	3.3	1.32
6*	2	66.6	0.62	5	2	1.5	0.60	5	2	123.3	1.15	5	2	3.1	1.24
9*	3	66.5	0.62	4	2	1.3	0.52	1	1	107.3	1.00	4	2	2.6	1.04
5	2	57.7	0.54	3*	1	1.2	0.48	4	2	107.0	1.00	1	1	2.5	1.00
2	1	55.7	0.52	7	3	1.1	0.44	7	3	104.5	0.97	2	1	2.0	0.80
4	2	55.4	0.50	9*	3	1.1	0.44	3*	1	84.2	0.78	8	3	2.0	0.80
7	3	34.9	0.33	6*	2	0.8	0.32	8	3	62.7	0.58	6*	2	1.7	0.68
8	3	20.9	0.19	8	3	0.7	0.28	2	1	55.7	0.52	3*	1	1.2	0.48
							BACKYARD SYSTEMS								
10	2	35.3	0.33	10	2	0.6	0.24	10	2	72.1	0.61	10	2	1.2	0.48
11	2	22.1	0.21	11	2	0.6	0.24	11	2	44.4	0.41	11	2	1.1	0.44

*Collection twice weekly.

Table 31

RANKING OF SYSTEMS BY COLLECTION COST EFFICIENCY

COLLECTION COST PER SERVICE PER WEEK				COLLECTION COST PER TON PER WEEK			
SYSTEM	CREW SIZE	COST	INDEX	SYSTEM	CREW SIZE	COST	INDEX
CURB AND ALLEY SYSTEMS							
1	1	0.13	1.00	1	1	5.42	1.00
5	2	0.15	0.87	2	1	5.75	0.94
4	2	0.16	0.81	5	2	6.09	0.89
2	1	0.20	0.65	4	2	6.54	0.83
3*	1	0.29	0.45	7	3	9.71	0.56
7	3	0.30	0.43	9*	3	10.26	0.53
9*	3	0.34	0.38	3*	1	10.42	0.52
8	3	0.36	0.36	8	3	11.07	0.49
6*	2	0.37	0.35	6*	2	15.40	0.35
BACKYARD SYSTEMS							
10	2	0.27	0.48	11	2	14.62	0.37
11	2	0.37	0.35	10	2	15.74	0.34

*Collection twice weekly.

backyard systems.

From Table 31, the following facts are readily apparent.

For both the collection cost per week and the collection cost per ton there is a strong tendency among the curb and alley systems for the smaller crew sizes to have the greatest collection cost efficiency.

There is no clear pattern among the backyard systems regarding collection cost efficiency.

Curb and alley systems tend to be more cost-efficient than backyard systems.

Discussion. Productivity and efficiency are interrelated with the factors that have already been considered previously. The total influence of these factors results in a collection rate per hour in terms of homes served and tons collected. Productivity has been considered from the standpoint of both the crew and the crewman. From the information that has been presented previously it appears that the system that has the greatest productivity per crewman and the best balance among all of the factors that influence system performance will have the best cost effectiveness and, hence, the greatest cost efficiency. Of the systems studied, System I clearly meets this requirement to a greater extent than any other system and, hence, has the best collection cost efficiency.

Conclusions. The following conclusions resulted from a consideration of the productivity and efficiency factors.

Curbside is more productive and cost efficient than backyard service.

For the curb and alley systems:

Systems that have a collection frequency of twice a week tend to serve more homes per collection hour, but collect fewer tons per collection hour, than their once-a-week counterparts.

The larger crew sizes have a tendency to collect more tons per collection hour.

When productivity and cost efficiency are considered on a per crewman basis, there is a strong tendency for the smaller crew sizes to have the greatest productivity and best cost efficiency.

For backyard systems:

The system which uses the task incentive system has a greater productivity than the system that uses the standard day incentive system.

There is no clear pattern between the backyard systems regarding collection cost efficiency.

Cost Analysis of Systems Performance

General. Standard cost data were used for all systems of the study effort to eliminate the effects of local cost variations and to facilitate a cost analysis of system performance. The standard costs were developed by using the average of available cost information from the 11 systems studied. By using standard costs any significant cost differences among the systems would then reflect differences in the operational performance of the systems. These differences may be related to the kind of equipment that was used and the cost of that equipment, the crew size, the frequency of collection, the storage point location, collection methodology and the incentive system used for the collection effort. In addition, the differences in cost would be related to the location of the route relative to the motor pool and also the location of the disposal point relative to the route. Since the study effort concentrated on the collection (on-route) phase of the operations, this aspect of the operation will be emphasized in the cost analysis.

The standard costs that were used in the study were as follows:

Initial Cost of Vehicles

Capacity (Cu. Yds.)	Side Loader	Rear Loader
13		$15,900
16		$16,700
18		$17,000
20		$22,700
25	$23,900	$23,900
33	$30,000	
Detachable Container Vehicle plus 1/4 cost of mother truck	$28,100	

Depreciation

The depreciation period is five years.

Maintenance Cost Per Year

Maintenance cost (first year) = .055 X initial cost of vehicle.

Consumable Costs

Fuel $0.17 per gallon. Engine oil $0.23 per quart.

Insurance and Fees

The yearly cost of insurance and fees is $1,200 per vehicle. The effective cost of insurance for one detachable container route (including mother truck) is $1,500 per year.

Salaries (Dollars per Hour)

Driver $4.34 Collectors $4.15 The effective cost of the detachable container crew (including mother truck driver) is $4.93 and $4.73 for the driver and collector respectively.

Fringe Benefits

Fringe benefits are 18.3 percent of salary.

Personnel Overhead

Personnel overhead is 13.1 percent of salary.

Overtime Factor

Overtime factor of 1.5 for drivers and collectors.

For this analysis cost data are grouped by systems on the basis of crew size and also on the basis of collection frequency. Cost data on the basis of crew size are summarized in Table 32. Data summarized on the basis of frequency of collection are provided in Table 33.

Facts. From Tables 32 and 33, the following facts are readily apparent.

There is considerable variation in the costs of the three phases of operation among all the systems. However, there is a general pattern among these costs. The cost of going to the route is a small percentage of the total cost to operate per day. In addition, the cost of going to the route is generally less than $10.00 and in most cases is less than $5.00 regardless of the crew size.

The cost to collect and the cost to transport vary considerably; however, there is a general pattern that reflects the influence of crew size.

The equipment costs for all systems are of the same order regardless of the kind of equipment being used, the initial cost of the equipment and the number of days per week it is used; although, the detachable container equipment and mother truck combination of System 6 is significantly greater in cost than the equipment of the other systems.

Table 32
SYSTEM COST DATA - COMPARISONS BY CREW SIZE

SYSTEM NUMBER	COST TO ROUTE PER DAY	COST TO COLLECT PER DAY	COST TO TRANSPORT PER DAY	EQUIPMENT COST PER DAY	MANPOWER COST PER DAY	TOTAL COST PER DAY	MANPOWER COST TO EQUIPMENT COST	COST PER TON	COST PER HOME PER WEEK	COLLECTION COST PER TON	COLLECTION COST PER HOME PER WEEK	RATIO COLLECTION COST TO TOTAL COST
CREW SIZE - 1 MAN												
1	4.32	51.07	22.77	32.54	45.62	78.16	1.40	8.29	0.19	5.42	0.13	0.65
2	1.60	51.75	22.80	30.70	45.44	76.14	1.49	8.46	0.30	5.75	0.20	0.68
3[a]	4.45	59.66	13.10	31.60	45.62	77.22	1.40	13.48	0.37	10.42	0.29	0.77
CREW SIZE - 2 MAN												
4	4.87	82.23	32.86	30.66	89.30	119.96	2.91	9.54	0.23	6.54	0.16	0.69
5	5.07	88.24	32.98	31.68	94.60	126.28	2.99	8.72	0.22	6.09	0.15	0.70
6[b]	4.34	107.14	35.70	43.69	103.48	147.17	2.37	21.15	0.51	15.40	0.37	0.73
10	2.94	97.23	18.88	28.74	90.31	119.05	3.14	19.27	0.32	15.74	0.27	0.82
11	2.78	90.25	20.63	23.98	89.68	113.66	3.74	18.41	0.47	14.62	0.37	0.79
CREW SIZE - 3 MAN												
7	6.25	122.52	32.80	28.70	132.87	161.57	4.63	12.82	0.39	9.71	0.30	0.76
8	3.93	107.14	54.88	30.18	135.77	165.95	4.50	17.13	0.55	11.07	0.36	0.65
9[b,c]	10.24	143.33	51.23	38.18	166.62	204.79	4.36	14.67	0.48	10.26	0.34	0.70

a. Operates six days per week.

b. Operates four days per week.

c. Normal work day is 10 hours.

Table 33

SYSTEM COST DATA - COMPARISONS BY COLLECTION FREQUENCY

SYSTEM NUMBER	COST TO ROUTE PER DAY	COST TO COLLECT PER DAY	COST TO TRANSPORT PER DAY	EQUIPMENT COST PER DAY	MANPOWER COST PER DAY	TOTAL COST PER DAY	MANPOWER COST TO EQUIPMENT COST	COST PER TON	COST PER HOME PER WEEK	COLLECTION COST PER TON	COLLECTION COST PER HOME PER WEEK	RATIO COLLECTION COST TO TOTAL COST
CURB AND ALLEY SYSTEMS - COLLECTION ONCE A WEEK												
1	4.32	51.07	22.77	32.54	45.62	78.16	1.40	8.29	0.19	5.42	0.13	0.65
2	1.60	51.75	22.80	30.70	45.44	76.14	1.49	8.46	0.30	5.75	0.20	0.68
4	4.87	82.23	32.86	30.66	89.30	119.96	2.91	9.54	0.23	6.54	0.16	0.69
5	5.07	88.24	32.98	31.68	94.60	126.28	2.99	8.72	0.22	6.09	0.15	0.70
7	6.25	122.52	32.80	28.70	132.87	161.57	4.63	12.82	0.39	9.71	0.30	0.76
8	3.93	107.14	54.88	30.18	135.77	165.95	4.50	17.13	0.55	11.07	0.36	0.65
CURB AND ALLEY SYSTEMS - COLLECTION TWICE A WEEK												
3[a]	4.45	59.66	13.10	31.60	45.62	77.22	1.40	13.46	0.37	10.42	0.29	0.77
6[b]	4.34	107.14	35.70	43.69	103.48	147.17	2.37	21.15	0.51	15.40	0.37	0.73
9[b,c]	10.24	143.33	51.23	38.18	166.62	204.79	4.36	14.67	0.48	10.26	0.34	0.70
BACKYARD SYSTEMS - COLLECTION ONCE A WEEK												
10	2.94	97.23	18.88	28.74	90.31	119.05	3.14	19.27	0.32	15.74	0.27	0.82
11	2.78	90.25	20.63	23.98	89.68	113.66	3.74	18.41	0.47	14.62	0.37	0.79

a. Operates six days per week.
b. Operates four days per week.
c. Normal work day is 10 hours.

Considering only those systems that collect five days a week, the average daily equipment cost was $29.64. The greatest cost per day was $32.54, and the least cost was $23.98.

Considering all systems, the average daily equipment cost was $31.87. The greatest cost was $43.69, and the least cost was $23.98.

The manpower cost per day is directly related to the crew size.

For every system studied the daily cost of equipment was significantly less than the daily manpower cost. This was true regardless of the initial cost of the vehicle and the number of days per week it was used. For the one-man systems the ratio of manpower costs to equipment costs averaged 1.43 and ranged from a low of 1.40 to a high of 1.49. For the two-man systems the ratio of the manpower costs to equipment costs averaged 3.03 and ranged from a low of 2.37 to a high of 3.74. For the three-man systems the ratio of the manpower costs to equipment costs averaged 4.50 and ranged from a low of 4.36 to a high of 4.63. These relationships indicate that from a cost standpoint the route operations are labor intensive operations, particularly as the crew size increases.

The total cost per ton, total cost per home per week, collection cost per ton and collection cost per week varied considerably among the systems. There was, however, a general correlation of costs by crew size, by frequency of collection and by storage location. Selected data have been extracted from Table 32, averaged, and presented in Table 34.

The ratio of daily collection costs to daily total costs was essentially of the same order for all systems. This ratio averaged 0.72 with a low of 0.65 and a high of 0.82.

Table 34

Table 34

SYSTEM AVERAGED COST RELATIONSHIPS

SYSTEM NUMBER	CREW SIZE	COLLECTION FREQUENCY	COST PER TON	RANGE	COST PER HOME PER WEEK	RANGE	COLLECTION COST PER TON	RANGE	COLLECTION COST PER HOME PER WEEK	RANGE
					CURB AND ALLEY SYSTEMS					
1 and 2	1	1	8.37	8.29-8.46	0.25	0.19-0.30	5.58	5.42-5.75	0.16	0.13-0.20
3	1	2	13.48	13.48	0.37	0.37	10.42	10.42	0.29	0.29
					CURB AND ALLEY SYSTEMS					
4 and 5	2	1	9.13	8.72-9.54	0.23	0.22-0.23	6.31	6.09-6.54	0.16	0.15-0.16
6	2	2	21.15	21.15	0.51	0.51	15.40	15.40	0.37	0.37
					CURB AND ALLEY SYSTEMS					
7 and 8	3	1	14.47	12.82-17.13	0.47	0.39-0.55	10.39	9.71-11.07	0.33	0.30-0.36
9	3	2	14.67	14.67	0.48	0.48	10.26	10.26	0.34	0.34
					BACKYARD SYSTEMS					
10 and 11	2	1	18.84	18.41-19.27	0.40	0.32-0.47	15.18	14.62-15.74	0.32	0.27-0.37

Discussion. Even with standard costs, there was considerable variation in the cost related factors of the collection system operations, although crew size, frequency of collection, and point of collection explained much of this. Differences in local costs would increase these cost variations. How then does the local collection system manager relate his costs to the systems study? While it is possible to convert systems study costs to local costs and vice versa, the most practical approach is to consider both the systems study performance and the local performance in terms of the local costs.

The total daily costs for a local operation may be determined by completing the form of Figure 29. The local daily costs can be related to the three phases of collection operations, and also to the cost per home per week, and cost per ton by the formulas provided in Figure 30.

The formulas for cost per home per week and cost per ton provide the local manager with a simple and powerful tool for analyzing his performance in terms of the performance of the systems studied. By using his daily costs per day, and the operational productivity and performance factors of the system or systems under consideration, the manager can make direct cost comparisons with his own performance.

To demonstrate the effect which various local labor rates would have on the collection cost per ton and collection cost per home per week, two tables of data have been prepared. Table 35 provides information on the collection cost per ton for various labor rates for each system. Table 36 provides information on the collection cost per home per week for various labor rates for each system. These tables can be used to approximate very closely what the collection costs per ton and per home per week would be using

FIGURE 29

PROCEDURE FOR DETERMINING LOCAL TOTAL PERFORMANCE COSTS PER DAY

Total Costs = Manpower Costs + Equipment Costs

Manpower Costs (Per Day)		
Labor Costs (Wages)	xxxxx	
Fringe Benefits Costs	xxxxx	
Personnel Overhead Costs	xxxxx	
Total Manpower Costs		xxxxx
Equipment Costs (Per Day)		
Depreciation	xxxxx	
Maintenance	xxxxx	
Daily Consumables (gas and oil)	xxxxx	
Other (Insurance, Fees, Etc.)	xxxxx	
Total Equipment Costs		xxxxx
Total Costs (Per Day)		xxxxx

FIGURE 30

PROCEDURE FOR DETERMINING LOCAL PERFORMANCE COSTS FOR COMPARISON WITH SYSTEM STUDIES COST

Cost to Route (Per Day)* =

$$\text{Local Total Cost (Per Day)} \times \frac{\text{Average Time to Route (Per Day)}}{\text{Average Total Time Worked (Per Day)}}$$

Cost to Collect (Per Day)* =

$$\text{Local Total Cost (Per Day)} \times \frac{\text{Average Time to Collect (Per Day)}}{\text{Average Total Time Worked (Per Day)}}$$

Cost to Transport (Per Day)* =

$$\text{Local Total Cost (Per Day)} \times \frac{\text{Average Time to Transport (Per Day)}}{\text{Average Total Time Worked (Per Day)}}$$

Cost Per Home Served (Per Week) =

$$\frac{\text{Local Total Costs (Per Day)} \times \text{Frequency of Collection (Per Week)}}{\text{Average Homes Served (Per Day)}}$$

Cost Per Ton =

$$\frac{\text{Local Total Costs (Per Day)}}{\text{Tons Collected (Per Day)}}$$

Collection Cost Per Home Served (Per Week) =

$$\frac{\text{Local Collection Costs (Per Day)} \times \text{Frequency of Collection (Per Wk)}}{\text{Average Homes Served (Per Day)}}$$

Collection Cost Per Ton =

$$\frac{\text{Local Collection Costs (Per Day)}}{\text{Average Tons Collected (Per Day)}}$$

* Cost by activity is determined on the basis of relative time spent on the activity. Therefore, the average total time worked per day serves as the basis for the activity costs, and not the total paid time. The total paid time is reflected in the total cost per day.

TABLE 35

THE EFFECT OF LABOR COSTS ON COLLECTION COST PER TON

1-Man Crew

System Number	Labor Rates								
	3.50	4.00	4.50	5.00	5.50	5.70*	6.00	6.50	7.00
1	4.19	4.47	4.75	5.02	5.30	5.41	5.58	5.85	6.13
2	4.43	4.73	5.03	5.33	5.63	5.75	5.93	6.23	6.53
3	8.04	8.58	9.12	9.66	10.20	10.41	10.74	11.28	11.81

2-Man Crew

System Number	Labor Rates									
	7.00	8.00	9.00	10.00	11.00	11.15*	12.00	12.70**	13.00	14.00
4	4.72	5.15	5.59	6.03	6.46	6.53	6.90	7.20	7.33	7.81
5	4.39	4.80	5.21	5.62	6.03	6.09	6.44	6.72	6.85	7.26
6	10.54	11.39	12.24	13.09	13.94	14.07	14.80	15.39	15.65	16.49
10	11.29	12.36	13.43	14.50	15.57	15.73	16.64	17.39	17.71	18.78
11	10.31	11.35	12.38	13.42	14.45	14.60	15.48	16.21	16.52	17.55

3-Man Crew

System Number	Labor Rates								
	10.50	12.00	13.50	15.00	16.50	16.60*	18.00	19.50	21.00
7	6.76	7.48	8.20	8.92	9.64	9.69	10.36	11.08	11.80
8	7.71	8.52	9.34	10.15	10.97	11.02	11.78	12.60	13.41
9	7.13	7.87	8.62	9.37	10.12	10.17	10.86	11.61	12.36

* Study Standard Rate
** Standard rate for System 6

TABLE 36

THE EFFECT OF LABOR COSTS ON COLLECTION COST PER HOME PER WEEK

1-Man Crew

System Number	Labor Rates								
	3.50	4.00	4.50	5.00	5.50	5.70*	6.00	6.50	7.00
1	0.10	0.10	0.11	0.12	0.12	0.13	0.13	0.13	0.14
2	0.16	0.17	0.18	0.19	0.20	0.20	0.21	0.22	0.23
3	0.22	0.24	0.25	0.27	0.28	0.29	0.30	0.32	0.33

2-Man Crew

System Number	Labor Rates									
	7.00	8.00	9.00	10.00	11.00	11.15*	12.00	12.70**	13.00	14.00
4	0.12	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18	0.19
5	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.18
6	0.26	0.28	0.30	0.32	0.34	0.34	0.36	0.37	0.38	0.40
10	0.19	0.21	0.23	0.25	0.26	0.27	0.28	0.30	0.30	0.32
11	0.26	0.29	0.31	0.34	0.37	0.37	0.39	0.41	0.42	0.45

3-Man Crew

System Number	Labor Rates								
	10.50	12.00	13.50	15.00	16.50	16.60*	18.00	19.50	21.00
7	0.21	0.23	0.25	0.28	0.30	0.30	0.32	0.34	0.37
8	0.24	0.27	0.30	0.32	0.35	0.35	0.37	0.40	0.43
9	0.24	0.26	0.28	0.31	0.33	0.34	0.36	0.38	0.41

* Study Standard Rate

** Standard Rate for System 6

local labor rates and assuming the study system performance. The formulas for deriving the information in the tables is provided as Appendix 4.

To determine the effect of an increase in the capital costs of equipment in the collection activities, an additional table has been prepared. Table 37 provides the incremental effect on collection cost per home per week and per ton of an increase in equipment costs of $1,000 for the systems studied.

A comparison of the information provided in Tables 35, 36, and 37 indicates that the cost per ton and per home served per week are rather insensitive to an additional cost of $1,000 in equipment costs, but highly sensitive to an increase in labor rates of $0.50 per hour. This is to be expected because with a depreciation period of five years for the equipment, the annual increment of additional cost would be only $200. This $200 would then be spread over the homes served per week and the tons collected per day. An increase in the pay rate of $0.50 per crewman per hour has the effect of adding approximately $1,000 per year per crewman in labor costs.

Since all systems studied were labor intensive in terms of relative equipment and manpower costs, it is clear that personnel costs should be the first item to consider in a cost reduction program. From a practical standpoint, personnel costs can be reduced in one of two ways, or a combination of both. The first is to improve the productivity of crews. The second is to reduce the number of crews or the size of the crews.

The analysis of crew size indicates that the productivity of crewmen has a strong tendency to increase as the crew size decreases. The greatest productivity per crewman is with the

TABLE 37

THE EFFECT OF CAPITAL COSTS ON COLLECTION RELATED COSTS

An increase of $1,000 in equipment cost has the following incremental effect on collection related costs. These costs are based on a 5 year depreciation period and the number of work days a year in each system.

System Number	Number Workdays/Year	Collection Cost/ Home/Week	Collection Cost/Ton
1	260	.001	.053
2	255	.002	.059
3*	310	.002	.087
4	261	.001	.041
5	261	.001	.035
6*	208	.002	.098
7	260	.001	.046
8	252	.002	.051
9*	207	.002	.047
10	255	.002	.103
11	260	.003	.098

*Collection twice weekly.

one-man crews. To reduce personnel costs, a logical avenue would be to reduce crew size and, at the same time, increase the productivity of crewmen. This procedure will enable the collection system to provide the same services with less personnel.

Since equipment costs were less than personnel costs for each system studied and the incremental effects of capital costs are small in comparison with personnel costs, the most productive equipment that meets the collection system requirements should be used. Compromising equipment or crew performance for the sake of a lower equipment cost appears to be counter productive.

Conclusions. The following conclusions resulted from a consideration of the system costs.

Regardless of the kind of equipment that was being used, the initial cost of the equipment, and the number of days per week the equipment was being used, the daily equipment costs were of the same general magnitude for all systems. The equipment costs for System 6 with the detachable container equipment and mother truck combination were significantly greater than the equipment costs for the other systems.

The daily personnel costs were related directly to the crew size.

For every system studied, the daily personnel costs were significantly more than the daily equipment costs. The manpower to equipment cost ratios averaged 1.4 for one-man crews, 3.0 for two-man crews, and 4.5 for three-man crews.

The incremental effect of an increase in equipment costs of $1,000 was small in comparison with an effective increase in labor costs per crewman of $0.50 per hour.

Since daily personnel costs are significantly more than the daily equipment costs, cost reduction programs should look first in the area of personnel costs. Personnel costs can be lowered by improving personnel productivity, by reducing the numbers of personnel or both. There is a strong tendency for personnel productivity to increase as crew size decreases.

Since incremental cost effects of an increase in equipment cost of $1,000 are small in comparison with an increase in the effective labor rate of $0.50 per hour, compromising equipment or crew performance for the sake of a lower equipment cost appears to be counter productive.

SECTION IV

PRODUCTIVITY AND EFFICIENCY MEASURES FROM REGRESSION ANALYSIS

General

Many of the parameters from the DAAP data were subjected to regression analysis to determine the significant relationships that existed among the collection system variables. These regression computer printouts are provided by Annex E of Volume III. In this section only those relationships that are associated with productivity and efficiency measures are considered.

All of the equations are in the form of $Y = aX_1 + bX_2 + cX_3 + dX_4 + e$. This form of the equation was found to provide the best representation of system performance. Five dependent variables (Y) were considered for analysis and included the following:

Collection minutes per service
Services per collection hour
Tons collected per collection hour
Total cost per service per week
Total cost per ton

Each of the dependent variables was considered in terms of the following independent variables:

X_1 = pounds per service per collection
X_2 = crew size
X_3 = percent one-way items
X_4 = collection miles per day

For each dependent variable the data were stratified into three groups as follows:

Curb and alley collecting once weekly
Curb and alley collecting twice weekly
Backyard collecting once weekly

The equations that resulted from these regressions define the dependent variables in terms of the operational performance of the systems studied. Since the data represent the four "best" routes of the "best" systems that could be found, the equations should be reliable predictors of expected performance based on local conditions. The equations, however, cannot be used to predict a performance outside the limits of the systems studied. For example, the equations cannot be used to predict the performance of a four man curb and alley system or a three man backyard system or a two man backyard system collecting twice weekly. Because there exists many systems that closely approximate the definition of the study systems, the regression models should have a broad general application.

The results of the regressions will be considered in the following sections. For each set of regressions the following information is presented: the number of data points used in the regression, the average values for the dependent and independent variables, the regression coefficients for the independent variables and the correlation of the independent variables with the dependent variables.

In all the regression equations derived for curb and alley systems collecting twice weekly, and only these systems, the crew size numbers of 1, 2 and 3 can also be used to represent type of equipment. In this case the number 1 represents the side loader, the number 2 represents the detachable container system, and the number 3 represents rear loading equipment.

Of the four independent variables considered only one is wholly outside the control of the solid waste collection manager. This one is the generation rate or pounds per service per collection. The other variables can be controlled to some extent. The crew size is completely within the control of the manager. The percent of one-way items may be influenced by the manager. This influence may range from prescribing bags be used completely to the creating of conditions whereby the use of more bags will be encouraged and used. The collection miles per day may also be influenced by the manager. By more efficient micro-routing and by placing some reasonable restrictions on travel for breaks which may be included in the collection phase of operations, the manager can favorably influence the collection miles per day to keep them at a minimum.

In general, the four independent variables have the following effects on the collection operations:

An increase in generation rates adversely affects productivity and efficiency parameters

An increase in crew size increases production and also increases the cost of providing services

An increase in the percentage of one-way items increases productivity and decreases the cost of providing services

An increase in collection miles decreases productivity and increases cost.

In the following paragraphs tables of data are provided for each of the dependent variables. In each table of data the correlation numbers provide an indication of the significance of the independent variables with respect to the dependent variable. The higher the correlation number the greater the significance of the variable.

From the manager's standpoint particular emphasis should be placed on those items that have the greatest influence on the collection operation and over which he exercises some control.

Collection Minutes Per Service

Collection minutes per service is one of the parameters directly related to the productivity of collection operations. The equations that resulted from the regression analyses are as follows:

Curb and Alley Collecting Once Weekly

$$Y = 0.76 + 0.01X_1 - 0.07X_2 - 0.05X_4$$

Curb and Alley Collecting Twice Weekly

$$Y = 0.44 + 0.01X_1 - 0.24X_2 + 0.01X_4$$

Backyard Collecting Once Weekly

$$Y = 0.75 + 0.01X_3$$

The results of the regression analyses are summarized in Table 38. The computer printouts for the regression runs are provided by Appendix 5.

Based on the values of R^2, the three equations can be expected to provide excellent results in projecting the collection minutes per service. In the worst case, curb and alley collecting once weekly, 81.0 percent of the variations in input data were explained on the basis of the designated independent variables. In the other two cases, better than 96 percent of variations were explained by the chosen input variations.

TABLE 38

COLLECTION MINUTES PER SERVICE

System	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
Curb alley 1/week	281	0.73	58.20	2.01	62.40	8.92	0.01	-0.07	----	-0.05	0.76	81.0
Curb alley 2/week	156	0.49	28.36	2.02	48.33	14.89	0.01	-0.24	----	0.01	0.44	96.9
Backyard 1/week	102	1.09	42.37	2.02	24.10	6.73	----	-----	0.01	----	0.78	98.1
		Standard Deviation					Simple Correlation With Y					
Curb alley 1/week	281	0.25	13.92	0.85	15.89	3.09	0.70	0.11	0.61	0.75		
Curb alley 2/week	156	0.17	4.70	0.82	8.25	4.44	0.22	0.95	0.42	0.15		
Backyard 1/week	102	0.27	10.89	0.03	20.60	1.04	0.79	0.25	0.99	0.14		

Services Per Collection Hour

Services per collection hour is one of the parameters directly related to the productivity of collection operations. The equations that resulted from the regression analyses are as follows:

Curb and Alley Collecting Once Weekly

$Y = 94.63 - 1.06X_1 + 0.55X_3 + 2.77X_4$

Curb and Alley Collecting Twice Weekly

$Y = 57.20 - 2.55X_1 + 54.14X_2 + 1.14X_3$

Backyard Collecting Once Weekly

$Y = 74.84 - 0.68X_3$

The results of the regression analyses are summarized in Table 39. The computer printouts for the regression runs are provided by Appendix 6.

Based on the values of R^2, the three equations can be expected to provide excellent results in projecting the number of services per collection hour. In the worst case, curb and alley collecting once weekly, 75.5 percent of the variations in input data were explained on the basis of the designated independent variables. In the other two cases, better than 96 percent of the variations were explained by the chosen input variables.

Tons Per Collection Hour

Tons per collection hour is one of the parameters directly related to the productivity of collection operations. The equations that resulted from the regression analyses are as follows:

Curb and Alley Collecting Once Weekly

$Y = -0.16 + 0.01X_1 + 0.14X_2 + 0.01X_3 + 0.12X_4$

Curb and Alley Collecting Twice Weekly

$Y = -1.72 + 0.02X_1 + 0.78X_2 + 0.03X_3$

TABLE 39

SERVICES PER COLLECTION HOUR

System	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
Curb alley 1/week	281	91.81	58.20	2.01	62.40	8.92	-1.06	-----	0.55	2.77	94.63	75.5
Curb alley 2/week	156	137.07	28.36	2.02	48.33	14.89	-2.55	54.14	1.14	----	57.20	96.6
Backyard 1/week	102	58.47	42.37	2.02	24.10	6.73	-----	-----	-0.68	----	74.84	98.2
		Standard Deviation					Simple Correlation With Y					
Curb alley 1/week	281	28.68	13.92	0.85	15.89	3.09	0.70	0.04	0.61	0.70		
Curb alley 2/week	156	46.99	4.70	0.82	8.25	4.44	0.38	0.97	0.61	0.36		
Backyard 1/week	102	14.11	10.89	0.03	20.60	1.04	0.78	0.25	0.99	0.14		

Backyard Collecting Once Weekly

$Y = 0.52 + 0.02X_1 - 0.01X_3$

The results of the regression analyses are summarized in Table 40. The computer printouts for the regression runs are provided by Appendix 7.

Based on the values of R^2, the first equation should be used cautiously. The R^2 value of 62.2 indicates there is a significant amount of the variations not explained by the designated variables. In the other two equations, better than 92 percent of the input data variations were explained by the chosen variables. These equations should provide excellent results in projecting the tons collected per collection hour.

Total Cost Per Service Per Week

Total cost per service per week is one of the parameters directly related to the efficiency of collection operations. The equations that resulted from the regression analyses are as follows:

Curb and Alley Collecting Once Weekly

$Y = 0.23 + 0.12X_2 - 0.01X_4$

Curb and Alley Collecting Twice Weekly

$Y = 0.66 + 0.09X_2 - 0.01X_3$

Backyard Collecting Once Weekly

$Y = -0.04 + 0.17X_2$

The results of the regression analyses are summarized in Table 41. The computer printouts for the regression runs are provided by Appendix 8.

Based on the values of R^2, the three equations can be expected to provide excellent results in projecting the cost per home per week. The R^2 in each case is better than 95 percent which means

TABLE 40

TONS PER COLLECTION HOUR

System	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
Curb alley 1/week	281	2.53	58.20	2.01	62.40	8.92	0.01	0.14	0.01	0.12	-0.16	62.2
Curb alley 2/week	156	2.01	28.36	2.02	48.33	14.89	0.02	0.78	0.03	----	-1.72	98.3
Backyard 1/week	102	1.18	42.37	2.02	24.10	6.73	0.02	----	-0.01	----	0.52	92.6
		Standard Deviation					Simple Correlation With Y					
Curb alley 1/week	281	0.58	13.92	0.85	15.89	3.09	0.05	0.28	0.65	0.62		
Curb alley 2/week	156	0.89	4.70	0.82	8.25	4.44	0.67	0.94	0.80	0.55		
Backyard 1/week	102	0.17	10.89	0.03	20.60	1.04	0.33	0.14	0.31	0.09		

TABLE 41

TOTAL COST PER SERVICE PER WEEK

System	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
Curb alley 1/week	281	0.33	58.20	2.01	62.40	8.92	----	0.12	-----	-0.01	0.23	95.1
Curb alley 2/week	156	0.46	28.36	2.02	48.33	14.89	----	0.09	-0.01	-----	0.66	97.1
Backyard 1/week	102	0.40	42.37	2.02	24.10	6.73	----	0.17	-----	-----	-0.04	98.7
		Standard Deviation					Simple Correlation With Y					
Curb alley 1/week	281	0.13	13.92	0.85	15.89	3.09	0.46	0.77	0.16	0.64		
Curb alley 2/week	156	0.06	4.70	0.82	8.25	4.44	0.09	0.72	0.13	0.39		
Backyard 1/week	102	0.07	10.89	0.03	20.60	1.04	0.79	0.16	0.99	0.13		

that most of the variations in cost have been explained by the chosen parameters.

In using these equations it must be remembered that the equations are based on the cost data used in the study; therefore, the equations must be used with caution. Local performance factors can be used to predict the costs in terms of the study. These costs must then be converted to local costs using the procedures described in Section III.

Total Cost Per Ton

Total cost per ton is one of the parameters directly related to the efficiency of collection operations. The equations that resulted from the regression analyses are as follows:

Curb and Alley Collecting Once Weekly

$$Y = 18.74 - 0.12X_1 + 4.02X_2 - 0.07X_3 - 0.44X_4$$

Curb and Alley Collecting Twice Weekly

$$Y = 45.03 - 0.56X_1 + 3.59X_2 - 0.36X_3 - 0.17X_4$$

Backyard Collecting Once Weekly

$$Y = 10.92 - 0.37X_1 + 10.13X_2 + 0.15X_3$$

The results of the regression analyses are summarized in Table 42. The computer printouts for the regression runs are provided by Appendix 9.

Based on the values of R^2, the three equations can be expected to provide excellent results in projecting the cost per ton. The R^2 in each case is 90 percent or better which means that most of the variations in cost have been explained by the chosen parameters.

In using these equations it must be remembered that the equations are based on the cost data used in the study; therefore, the equations must be used with caution. Local performance factors can be used to predict the costs in terms of the study. These

TABLE 42

TOTAL COST PER TON

System	Data Points	Average Values					Coefficients of Variables				Constant Term	R^2
		Y	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4		
Curb alley 1/week	281	11.45	58.20	2.01	62.40	8.92	-0.12	4.02	-0.07	-0.44	18.74	90.0
Curb alley 2/week	156	16.72	28.36	2.02	48.33	14.89	-0.56	3.59	-0.36	-0.17	45.03	95.1
Backyard 1/week	102	19.15	42.37	2.02	24.10	6.73	-0.37	10.13	0.15	-----	10.92	93.9
		Standard Deviation					Simple Correlation With Y					
Curb alley 1/week	281	3.87	13.92	0.85	15.89	3.09	0.14	0.76	0.03	0.46		
Curb alley 2/week	156	3.85	4.70	0.82	8.25	4.44	0.79	0.07	0.66	0.71		
Backyard 1/week	102	2.63	10.89	0.03	20.60	1.04	0.64	0.07	0.05	0.03		

costs must then be converted to local costs using the procedures described in Section III.

APPENDIX I

```
                            (1)      DATA ACQUISITION AND ANALYSIS PROGRAM
                                          DAAP COMPUTER PROGRAM OUTPUT
                            (2)        COLLECTION SYSTEM DESCRIPTION REPORT

                            (3) PERIOD FOR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
***************************************************************************************************************************************
*  (4)   *    (5)    *   (6)   *  (7)  * (8)  *   (9)   *   (10)   *     (11)      *    (12)    * (13)  *            (14)             *
* SYSTEM * OPERATING * TOTAL   * TYPE  * CREW * COLLECT * POINT    * COLLECTION    * INCENTIVE  * UNION *      TYPE OF                *
* NUMBER * AGENCY    * NUMBER  * OF    * SIZE * PER     * OF       * METHODOLOGY   * SYSTEM     * REPR. *      STORAGE CONTAINERS     *
*        *           * OF      * EQUIP *      * WEEK    * COLLECT  *               *            *       *         *         *         *
*        *           * ROUTES  *       *      *         *          *               *            *       * % BAGS  * % CANS  * % MISC  *
***************************************************************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in this report.

(3) The period for which the information of the report applies.

(4) Indicates the system number under study. Systems are numbered in the sequence designated in the contract scope of work.

(5) Indicates whether the system being studied operates under a public or private organization.

(6) Indicates the total number of routes being monitored for each system. Four routes were monitored for each system.

(7) Indicates the general type of equipment being used by the system. RL indicates rear loader, SL indicates side loader (all side loaders in the study were the Shu-Pak), and EVO indicates the LoDal mobile transfer system.

(8) Indicates the size of the normal crew, including the driver.

(9) Indicates the number of normal collections received by a resident per week.

(10) Indicates whether collections are made from the curb and/or alley or from the backyard.

(11) Indicates whether the collections are made from one side or both sides of the street or by using a totebarrel for backyard systems.

(12) Indicates whether the incentive system is the task system or the standard 8-hour day. In the task system the crew is finished when the designated work has been completed. In the 8-hour day system the crew is required to work the full day.

(13) Indicates whether or not the crews are represented by a union.

(14) Indicates the percentage of storage containers by type that was encountered during the last time motion study or backyard survey.

```
                          (1)          DATA ACQUISITION AND ANALYSIS PROGRAM
                                          DAAP COMPUTER PROGRAM OUTPUT
                          (2)            DETAILED VEHICLE - CREW REPORT

                          (3)     PERIOD FUR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
*********************************************************************************************************************************
*   (4)   *   (5)   *  (6)   *                    (7)                      *  (8)   *        (9)          *        (10)         *
* ROUTE   *  SIZE   * AGE    *            EQUIPMENT COST PER               *  AVG   * CREW HOURLY LABOR   *    HOURS WORKED     *
* NUMBER  *  AND    * ECUIP  *           OPERATING DAY (DOLLARS)           *  CREW  * RATE (DOLLARS)      *    PER WEEK         *
*         *  TYPE   * (YEARS) ***************************************** SIZE   ***************************************
*         *         *        *DEPRECI- * MAINTE- * CONSUM-  *INSURANCE*         * DRIVER   *COLLECTER* PLANNED * ACTUAL   *
*         *         *        *ATION    * NANCE   * ABLES    *AND FEES *         *          *         *         *          *
*         *         *        *         *         *          *         *         *          *         *         *          *
*********************************************************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in the report.

(3) The period for which the information of the report applies.

(4) Identifies the system and route by means of a four digit number. The first two digits indicate the system number and the second two digits indicate the route number of the system.

(5) Indicates the average size of the vehicle used on the route and its general type. The average size takes into consideration substitute vehicles of different sizes. The abbreviations for vehicle type that were used in the Collection System Description Report are also used in this report.

(6) Indicates the age of the equipment being used. For the purposes of this study all equipment was considered to be in its first year of operation.

(7) Indicates the equipment related costs per day. Four equipment costs are provided. These are depreciation, maintenance, consumables, and insurance and fees. Standard procedures are used for determining each of these costs.

For depreciation the useful life is considered to be five years. The yearly depreciation is divided by the number of normal working days per year to obtain the daily depreciation increment.

The annual maintenance cost for the FIRST YEAR is considered to be 5.5 percent of the total equipment cost. This value is divided by the number of normal working days per year to obtain the daily maintenance increment.

The consumables cost is based on the actual consumption of fuel and engine oil. Standard costs are used per gallon of fuel and per quart of engine oil.

The insurance and fees are assumed to be $1200 per year per vehicle. This value is divided by the number of normal working days per year to determine the daily increment.

(8) Indicates the average crew size used during the period and takes into consideration the addition or deletion of crew members as the need arises. The crew size includes the driver.

(9) Indicates the EFFECTIVE hourly labor rate for the driver and collector. This labor rate includes fringe benefits and personnel overhead.

(10) Indicates the number of hours per week that are planned and actually worked. The planned number is based on the normal work week and the number of days of data being submitted per week. The number of hours actually worked per week include the daily work efforts from the time the crew leaves the motor pool in the morning until the return to the motor pool at the end of the day.

```
            (1)        DATA ACQUISITION AND ANALYSIS PROGRAM
                            DAAP COMPUTER PROGRAM OUTPUT
            (2)            DETAILED ROUTE OPERATIONS REPORT

            (3)  PERIOD FOR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
****************************************************************************************
*  (4)   *       (5)       *       (6)       *       (7)       * TO ROUTE, (8) *           (9)            *   (10)    *   (11)    *
* ROUTE  * MOTOR POOL      * COLLECTION      * TRANSPORT       * COLLECTION,   * DISCHARGE                * AVG WT    * AVG       *
* NUMBER * TO ROUTE        * OPERATION       * OPERATION       * TRANSPORT     * POINT                    * COLLECTED * LOADS     *
*        * (PER DAY)       * (PER DAY)       * (PER DAY)       * (PER DAY)     *(LOADS PER DAY)           * (PER DAY) * (PER DAY) *
*        ***************************************************************************************** (TONS)    *           *
*        *        *        *        *        *        *        *       *       *        * LAND   * XFER   *           *           *
*        * MILES  * HOURS  * MILES  * HOURS  * MILES  * HOURS  * MILES * HOURS * INCIN  * FILL   * STA    *           *           *
****************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in the report.

(3) The period for which the information of the report applies.

(4) Identifies the system and route by means of a four digit number. The first two digits indicate the system number, and the second two digits indicate the route number of the system.

(5), (6) & (7). Crew activities are viewed in three phases.

The first phase (5) begins with leaving the motor pool and ends with the first collection.
The second phase (6) represents the total collection effort irrespective of the number of loads. For each load the collection phase begins with the first collection and ends with the last collection to complete the load.
The third phase (7) represents the total transport effort and includes returning to the motor pool for the last load of the day. For each load the transport effort begins with the completion of the last collection to make a load and ends with the first collection of a new load or a return to the motor pool for the day. For each phase the average miles traveled per day and the average time in hours per day is presented. The times and mileages exclude that time and mileage associated with down time and lunch time but does include coffee break time.

(8) Represents the average total time spent per day in performing the three phases of the crew activities. Down time and lunch time are excluded from this total time.

(9) Indicates the number of loads per day which are transported to the disposal sites listed.

(10) Indicates the average weight collected per day in tons.

(11) Indicates the average number of loads collected per day.

Note: For each of the columns of (5) through (11) a sum, average, and accumulative average (YTD = Year to Date, the accumulative average) is provided.

```
                    (1)          DATA ACQUISITION AND ANALYSIS PROGRAM
                                     DAAP COMPUTER PROGRAM OUTPUT
                    (2)              COLLECTION ROUTE COST REPORT

                    (3)    PERIOD FOR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
*******************************************************************************************************************
*  (4)   *   (5)   *   (6)   *   (7)   *  (8)   *   (9)   *   (10)   *   (11)    *  (12)     *  (13)    *  (14) *   (15)     *
* ROUTE  * COST TO * COST TO * COST TO * EQUIP  * MANPOWER* TOTAL    * TOTAL     * TOTAL     * TOTAL    * COST  * COST PER   *
* NUMBER * ROUTE   * COLLECT *TRANSPORT* COST   * COST    * COST     * BREAKDOWN * INCENTIVE * OVERTIME * PER   *    HOME    *
*        * PER DAY * PER DAY * PER DAY * PER DAY* PER DAY * PER DAY  * COST      * COST      * COST     * TON   * SERVICED   *
*        *         *         *         *        *         *          * (MANPOWER)*           *          *       ************
*        *         *         *         *        *         *          *           *           *          *       * WEEK* YEAR*
*******************************************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in the report.

(3) The period for which the information of the report applies.

(4) Identifies the system and route by means of a four digit number. The first two digits indicate the system number, and the second two digits indicate the route number of the system.

(5) Indicates the sum of the equipment and personnel costs per day to travel from the motor pool to the first collection. These costs are based on the time required to perform this operation.

(6) Indicates the sum of the equipment and personnel costs per day to complete the total collection phase of the effort. These costs are based on the time required to complete the collection effort.

(7) Indicates the sum of the equipment and personnel costs per day to complete the transport phase of the effort. These costs are based on the time required to complete the transport effort.

(8) Indicates the total cost of operating the equipment per day and includes the costs of depreciation, maintenance, daily consumables, and insurance and fees.

(9) Indicates the total personnel costs per day. The personnel costs will include the time to route, collect, transport and overtime costs. All time worked in excess of the normally paid workday, including time associated with a breakdown and excess lunch time, will be used to compute overtime costs. The personnel costs include the costs of labor, fringe benefits and personnel overhead.

(10) Indicates the total daily equipment and personnel costs per day. This total cost is also the sum of the costs to go to the route, to collect and to transport.

(11) Indicates the total personnel operating costs of the breakdowns in the period based on the daily manpower costs, the productive time, and the time required to solve the breakdown problems. This cost does NOT include the actual parts and maintenance labor costs associated with correcting the breakdown problem. This cost provides an indication of the lost production associated with breakdowns.

(12) Indicates the total money paid to the crew during the period which is paid when the crew is not working a full standard day.

(13) Indicates the total money paid to the crew during the period which is paid when the crew works longer than the standard day.

(14) Indicates the total equipment and personnel costs required to collect and transport one ton of solid waste to the disposal point.

(15) Indicates the total equipment and personnel costs required to service one family unit per week and per year.

<u>Note:</u> For each of the columns of (5) through (15) a sum, average, and accumulative average (YTD = Year to Date, the accumulative average) is provided where this is meaningful.

```
                     (1)        DATA ACQUISITION AND ANALYSIS PROGRAM
                                   DAAP COMPUTER PROGRAM OUTPUT
                     (2)         COLLECTION CREW PRODUCTIVITY REPORT

                     (3)  PERIOD FOR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
*****************************************************************************************************************************************
*  (4)   *      (5)      *         (6)          *    (7)     *   (8)     * CREW PRODUCTIVITY(9)* COLLECTOR PRODUCTIVITY (10)*  (11)  *
* ROUTE  *     HOMES     * AVERAGE WEIGHT       * COLLECT    * COLLECT *****************************************************        *
*        *     SERVED    * COLLECTED PER HOME*  TIME PER   * TIME      * HOMES     * WEIGHT     *HOMES SERVED   *WEIGHT          *INDEX   *
* NUMBER *************************************** HOME PER   * PER       * SERVED    * HANDLED    *PER COLLECTOR  *HANDLED PER     *  OF    *
*        * PER   * PER   * PER        * PER     * COLLECTION* 100 LBS.* PER       * PER        *PER COLLECTION*COLLECTOR PER*PRODUCT-*
*        * DAY   * WEEK  * COLLECT-*   WEEK     * (MINUTES) * (MINS)  *COLLECTION*COLLECTION*HOUR            *COLLECTION      *IVITY   *
*        *       *       * ION(LBS)*   (LBS)    *           *         * HOUR      *HOUR(TONS)*                *HOUR(TONS)      *        *
*****************************************************************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in the report.

(3) The period for which the information of the report applies.

(4) Identifies the system and route by means of a four digit number. The first two digits indicate the system number and the second two digits indicate the route number of the system.

(5) Indicates the average number of homes served on a daily and weekly basis. This takes into consideration more than one scheduled collection per week.

(6) Indicates the average weight collected per home on a daily and weekly basis. This takes into consideration more than one scheduled collection per week.

(7) Indicates the average time in minutes which is required to serve one home during each collection day.

(8) Indicates the average time in minutes which is required to collect 100 pounds of solid waste from the route during each collection day.

(9) Provides a measure of crew productivity in terms of the number of homes served per collection hour and the number of tons collected per collection hour.

(10) Provides a measure of collector productivity in terms of the number of homes served per collector per collection hour and the number of tons collected per collector per collection hour. For the purposes of this item each one-man system is considered to have one collector, each two-man system is considered to have one collector, and each three-man system is considered to have two collectors.

(11) Provides a rough measure of the relative productivity of each route and each system.

<u>Note:</u> For each of the columns of (5) through (11) a sum, average, and accumulative average (YTD = Year to Date, the accumulative average) is provided.

```
                           (1)         DATA ACQUISITION AND ANALYSIS PROGRAM
                                           DAAP COMPUTER PROGRAM OUTPUT
                           (2)         COLLECTION SYSTEM EFFICIENCY REPORT

                           (3)   PERIOD FOR WHICH DATA APPLIES 01/02/74 THRU 01/31/74
****************************************************************************************************************************
* (4)  *  (5)  *    (6)   *   (7)   *   (8)   *          (9)           *  (10)    *      (11)      * (12)   *     (13)     *
*ROUTE * RATIO * RATIO    * RATIO   * RATIO   *COLLECTION RELATED COSTS* WEIGHT   *     AVERAGE    * WEIGHT * INDEX OF     *
*      * WORK  *COLLECTION* EQUIP   * MANPOWER*                        * HANDLED  * WEIGHT PER LOAD* PER CU.* ROUTE        *
*NUMBER* TIME  * TIME     * COST    * COST TO ************************** PER      *     (TONS)     * YARD   * EFFICIENCY   *
*      * TO    * TO       * TO      * TOTAL   *COLLECTION *COLLECTION  * COLLECTOR****************** FIRST  *              *
*      * STD.  * TIME     * MANPOWER* COST    *COST PER   *COST PER TON* PER DAY  * FIRST  * ALL   * LOAD   *              *
*      * TIME  * WORKED   * COST    *         *HOME SERVED*COLLECTED   * (TONS)   * LOAD   * OTHERS*(POUNDS)*              *
****************************************************************************************************************************
```

(1) This heading identifies the Data Acquisition and Analysis Program.

(2) Identifies the kind of information in the report.

(3) The period for which the information of the report applies.

(4) Identifies the system and route by means of a four digit number. The first two digits indicate the system number, and the second two digits indicate the route number of the system.

(5) Indicates the proportion of the standard work day that is spent in going to the route, collecting and transporting waste, the time spent on breakdowns and the excess lunch time.

(6) Indicates the proportion of time spent in collecting waste in comparison with the total time spent in going to the route, collecting and transporting waste, the time spent on breakdowns, and the excess lunch time.

(7) Indicates the relationship of the daily equipment cost in comparison to the daily manpower cost.

(8) Indicates the proportion of the daily total cost that is associated with manpower costs.

(9) Indicates the cost per home served and the cost per ton collected based only on the total cost of the collection phase of operations.

(10) Indicates the total tons of waste handled per collector per day.

(11) Indicates the average weight per load in tons for the first load of the day and for all subsequent loads per day.

(12) Indicates the degree of compaction being obtained on the first load with the equipment being used and the solid waste being collected. It is assumed that the first load in all cases is a full load.

(13) Provides a rough measure of the relative efficiency of each route and each system.

```
                                       APPENDIX 2
                            DATA ACQUISITION AND ANALYSIS PROGRAM
                               DAAP COMPUTER PROGRAM OUTPUT
                            COLLECTION SYSTEM DESCRIPTION REPORT

                            PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
***********************************************************************************************************************
*         *           * TOTAL   * TYPE  * CREW * COLLECT * POINT    * COLLECTION   * INCENTIVE * UNION *                              *
* SYSTEM  * OPERATING * NUMBER  * OF    * SIZE * PER     * OF       * METHODOLOGY  * SYSTEM    * REPR. *         TYPE OF              *
* NUMBER  * AGENCY    * OF      * EQUIP *      * WEEK    * COLLECT  *              *           *       *    STORAGE CONTAINERS        *
*         *           * ROUTES  *       *      *         *          *              *           *       *          *          *        *
*         *           *         *       *      *         *          *              *           *       * % BAGS   * % CANS   * % MISC *
***********************************************************************************************************************

   01       PUBLIC        4       SL      1.0      1      CURB-ALLEY  ONE-SIDE      TASK        NO       34.0       52.0       14.0

   02       PUBLIC        4       SL      1.0      1      CURB-ALLEY  ONE-SIDE      8 HR DAY    NO       26.0       53.0       21.0

   03       PUBLIC        4       SL      1.0      2      CURB-ALLEY  ONE-SIDE      TASK        YES      29.0       53.0       18.0

   04       PRIVATE       4       RL      2.0      1      CURB-ALLEY  ONE-SIDE      TASK        YES      56.0       28.0       16.0

   05       PUBLIC        4       RL      2.0      1      CURB-ALLEY  ONE-SIDE      8 HR DAY    YES      85.0        6.0        9.0

   06       PUBLIC        4       DC      2.0      2      CURB-ALLEY  ONE-SIDE      TASK        YES      19.0       61.0       20.0

   07       PUBLIC        4       RL      3.0      1      CURB-ALLEY  BOTH SIDES    TASK        YES      56.0       28.0       16.0

   08       PUBLIC        4       RL      3.0      1      CURB-ALLEY  BOTH SIDES    8 HR DAY    YES      25.0       47.0       28.0

   09       PUBLIC        4       RL      3.0      2      CURB-ALLEY  BOTH SIDES    TASK        YES      46.0       41.0       13.0

   10       PUBLIC        4       RL      2.0      1      BACKYARD    TOTE-BARREL   TASK        NO        2.0       96.0        2.0

   11       PUBLIC        4       RL      2.0      1      BACKYARD    TOTE-BARREL   8 HR DAY    YES      33.0       55.0       12.0
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                    DATA ACQUISITION AND ANALYSIS PROGRAM
                        DAAP COMPUTER PROGRAM OUTPUT
                       DETAILED VEHICLE - CREW REPORT

                   PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
************************************************************************************************************
* ROUTE  *  SIZE   * AGE    *                                          *  AVG  * CREW HOURLY LABOR *  HOURS WORKED   *
* NUMBER *  AND    * EQUIP  *        EQUIPMENT COST PER                *  CREW * RATE (DOLLARS)    *   PER WEEK      *
*        *  TYPE   *(YEARS) *      OPERATING DAY (DOLLARS)             *  SIZE *****************************************
*        *         *        ********************************************       * DRIVER *COLLECTOR* PLANNED * ACTUAL *
*        *         *        *DEPRECI- * MAINTE- * CONSUM- *INSURANCE*          *        *          *         *        *
*        *         *        *ATION    * NANCE   * ABLES   *AND FEES *          *        *          *         *        *
************************************************************************************************************

  01-01   25.0-SL    1.0     18.38     5.06      3.44      4.62       1.0     5.70      0.00      40.00     28.61
  01-02   25.0-SL    1.0     18.38     5.06      4.25      4.62       1.0     5.70      0.00      40.00     31.13
  01-03   25.0-SL    1.0     18.38     5.06      5.68      4.62       1.0     5.70      0.00      40.00     29.31
  01-04   25.0-SL    1.0     18.38     5.06      4.54      4.62       1.0     5.70      0.00      40.00     29.43
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  02-01   25.0-SL    1.0     18.75     5.15      2.06      4.71       1.0     5.70      0.00      40.00     33.94
  02-02   25.0-SL    1.0     18.75     5.15      2.03      4.71       1.0     5.70      0.00      40.00     34.08
  02-03   25.0-SL    1.0     18.75     5.15      2.12      4.71       1.0     5.70      0.00      40.00     32.88
  02-04   25.0-SL    1.0     18.75     5.15      2.19      4.71       1.0     5.70      0.00      40.00     34.06
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  03-01   33.0-SL    1.0     19.35     5.32      3.00      3.87       1.0     5.70      0.00      48.00     37.89
  03-02   33.0-SL    1.0     19.35     5.32      3.02      3.87       1.0     5.70      0.00      48.00     38.67
  03-03   33.0-SL    1.0     19.35     5.32      3.11      3.87       1.0     5.70      0.00      48.00     37.33
  03-04   33.0-SL    1.0     19.35     5.32      3.06      3.87       1.0     5.70      0.00      48.00     38.62
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  04-01   20.0-RL    1.0     17.39     4.78      4.13      4.60       2.0     5.70      5.45      40.00     38.98
  04-02   20.0-RL    1.0     17.39     4.78      3.51      4.60       2.0     5.70      5.45      40.00     33.20
  04-03   20.0-RL    1.0     17.39     4.78      3.91      4.60       2.0     5.70      5.45      40.00     37.26
  04-04   20.0-RL    1.0     17.39     4.78      4.01      4.60       2.0     5.70      5.45      40.00     33.07
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  05-01   23.6-RL    1.0     18.31     5.04      3.54      4.60       2.0     5.70      5.45      40.00     34.22
  05-02   24.3-RL    1.0     18.31     5.04      3.90      4.60       2.0     5.70      5.45      40.00     35.68
  05-03   24.9-RL    1.0     18.31     5.04      3.59      4.60       2.1     5.70      5.45      40.00     35.98
  05-04   24.0-RL    1.0     18.31     5.04      3.90      4.60       2.1     5.70      5.45      40.00     34.84
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                              DATA ACQUISITION AND ANALYSIS PROGRAM
                                   DAAP COMPUTER PROGRAM OUTPUT
                                 DETAILED VEHICLE - CREW REPORT

                         PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*******************************************************************************************************
*         *         *         *                                        *       *                  *                   *
* ROUTE   *  SIZE   * AGE     *        EQUIPMENT COST PER              * AVG   * CREW HOURLY LABOR *   HOURS WORKED    *
* NUMBER  *  AND    * EQUIP   *        OPERATING DAY (DOLLARS)         * CREW  * RATE (DOLLARS)    *   PER WEEK        *
*         *  TYPE   * (YEARS) ****************************************** SIZE  *************************************
*         *         *         *DEPRECI- * MAINTE- * CONSUM- *INSURANCE*        * DRIVER  *COLLECTOR* PLANNED * ACTUAL  *
*         *         *         *ATION    * NANCE   * ABLES   *AND FEES *        *         *         *         *         *
*         *         *         *         *         *         *         *        *         *         *         *         *
*******************************************************************************************************

   06-01    8.0-DC     1.0     27.02     7.43      2.04      7.21      2.1      6.48      6.22     32.00     23.23
   06-02    8.0-DC     1.0     27.02     7.43      2.00      7.21      2.0      6.48      6.22     32.00     22.98
   06-03    8.0-DC     1.0     27.02     7.43      2.08      7.21      2.0      6.48      6.22     32.00     23.01
   06-04    8.0-DC     1.0     27.02     7.43      2.00      7.21      2.0      6.48      6.22     32.00     24.08

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   07-01   19.9-RL     1.0     17.46     4.80      1.82      4.62      3.0      5.70      5.45     40.00     24.67
   07-02   20.1-RL     1.0     17.46     4.80      1.75      4.62      3.0      5.70      5.45     40.00     28.22
   07-03   20.0-RL     1.0     17.46     4.80      1.99      4.62      3.0      5.70      5.45     40.00     27.61
   07-04   20.0-RL     1.0     17.46     4.80      1.72      4.62      3.0      5.70      5.45     40.00     23.62

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   08-01   24.5-RL     1.0     18.97     5.22      3.53      4.76      3.0      5.70      5.45     40.00     40.80
   08-02   18.5-RL     1.0     13.49     3.71      2.41      4.76      3.0      5.70      5.45     40.00     38.96
   08-03   24.6-RL     1.0     18.97     5.22      3.08      4.76      3.0      5.70      5.45     40.00     38.41
   08-04   24.3-RL     1.0     18.97     5.22      2.88      4.76      3.0      5.70      5.45     40.00     38.74

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   09-01   20.0-RL     1.0     21.93     6.03      4.95      5.80      3.0      5.70      5.45     40.00     30.33
   09-02   20.0-RL     1.0     21.93     6.03      4.98      5.80      3.0      5.70      5.45     40.00     21.99
   09-03   20.0-RL     1.0     21.93     6.03      3.20      5.80      3.0      5.70      5.45     40.00     21.61
   09-04   20.0-RL     1.0     21.93     6.03      4.54      5.80      3.0      5.70      5.45     40.00     27.66

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   10-01   20.0-RL     1.0     17.80     4.90      1.32      4.71      2.0      5.70      5.45     40.00     32.06
   10-02   20.0-RL     1.0     17.80     4.90      1.23      4.71      2.0      5.70      5.45     40.00     30.59
   10-03   20.0-RL     1.0     17.80     4.90      1.35      4.71      2.0      5.70      5.45     40.00     31.52
   10-04   20.0-RL     1.0     17.80     4.90      1.42      4.71      2.1      5.70      5.45     40.00     31.13

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   11-01   13.6-RL     1.0     12.85     3.53      1.84      4.62      2.0      5.70      5.45     40.00     34.88
   11-02   13.2-RL     1.0     12.23     3.38      2.12      4.62      2.0      5.70      5.45     40.00     34.37
   11-03   19.4-RL     1.0     17.46     4.80      1.65      4.62      2.0      5.70      5.45     40.00     34.59
   11-04   13.7-RL     1.0     12.23     3.36      2.04      4.62      2.0      5.70      5.45     40.00     35.18

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                                        DATA ACQUISITION AND ANALYSIS PROGRAM
                                           DAAP COMPUTER PROGRAM OUTPUT
                                          CETAILED ROUTE OPERATIUNS REPORT

                                   PERIUD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*****************************************************************************************************************************
*        *                *                *                *                *                        *           *          *
* ROUTE  * MOTOR POOL     * CCLLECTION     * TRANSPORT      * TO ROUTE,      * DISCHARGE              * AVG WT    * AVG      *
* NUMBER * TO ROUTE       * OPERATION      * UPERATION      * COLLECTION,    * POINT                  * COLLECTED * LOADS    *
*        * (PER DAY)      * (PER DAY)      * (PER DAY)      * TRANSPORT      *(LOADS PER DAY)         * (PER DAY) * (PER DAY)*
*        *                *                *                * (PER DAY)      *                        * (TONS)    *          *
*        ************************************************************************************************           *          *
*        *        *       *        *       *        *       *        *       *        * LAND * XFER  *           *          *
*        * MILES  * HOURS * MILES  * HOURS * MILES  * HOURS * MILES  * HOURS * INCIN  * FILL * STA   *           *          *
*****************************************************************************************************************************

  01-01      9.3    0.39     11.7    3.77     45.3    1.55     66.3    5.70     0.0     1.8    0.0       8.93         1.8
  01-02      9.0    0.30      9.0    4.06     49.9    1.83     67.9    6.19     0.0     1.7    0.0       9.24         1.7
  01-03      7.5    0.30      9.0    3.67     47.9    1.79     64.4    5.76     0.0     1.7    0.0       9.99         1.7
  01-04      7.7    0.31     12.3    3.84     41.4    1.67     61.4    5.82     0.0     1.8    0.0       9.59         1.8

   SUM      33.4    1.30     42.1   15.34    184.5    6.84    260.0   23.47     0.0     7.1    0.0      37.74         7.1
   AVG       8.4    0.32     10.5    3.83     46.1    1.71     65.0    5.87     0.0     1.8    0.0       9.44         1.8
   YTD       8.4    0.32     10.5    3.83     46.1    1.71     65.0    5.87     0.0     1.8    0.0       9.44         1.8
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  02-01      1.8    0.12      8.8    4.76     21.7    1.85     32.3    6.72     0.0     1.5    0.0       9.12         1.5
  02-02      2.1    0.15      6.8    4.44     25.4    2.20     34.2    6.79     0.0     1.7    0.0       9.05         1.7
  02-03      1.2    0.12      6.4    4.48     22.4    1.95     30.0    6.55     0.0     1.6    0.0       9.05         1.6
  02-04      0.3    0.18      2.4    4.55      5.8    2.04      8.6    6.77     0.0     1.7    0.0       6.78         1.7

   SUM       5.4    0.56     24.5   18.24     75.3    8.04    105.1   26.84     0.0     6.6    0.0      35.99         6.5
   AVG       1.4    0.14      6.1    4.56     18.8    2.01     26.3    6.71     0.0     1.6    0.0       9.00         1.6
   YTD       1.4    0.14      6.1    4.56     18.8    2.01     26.3    6.71     0.0     1.6    0.0       9.00         1.6
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  03-01      7.7    0.36     13.9    4.93     21.8    1.00     43.4    6.30     0.0     1.0    0.0       5.48         1.0
  03-02      7.5    0.39     11.8    4.91     22.3    1.14     41.5    6.43     0.0     1.0    0.0       5.76         1.0
  03-03      9.3    0.38     13.7    4.68     22.0    1.09     45.0    6.16     0.0     1.0    0.0       5.71         1.0
  03-04      7.5    0.32     15.7    5.00     22.6    1.06     45.8    6.38     0.0     1.0    0.0       5.98         1.0

   SUM      32.0    1.46     55.0   19.53     88.7    4.29    175.7   25.28     0.0     4.1    0.0      22.93         4.1
   AVG       8.0    0.36     13.7    4.88     22.2    1.07     43.9    6.32     0.0     1.0    0.0       5.73         1.0
   YTD       8.0    0.36     13.7    4.88     22.2    1.07     43.9    6.32     0.0     1.0    0.0       5.73         1.0
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                       DATA ACQUISITION AND ANALYSIS PROGRAM
                           DAAP COMPUTER PROGRAM OUTPUT
                         DETAILED ROUTE OPERATIONS REPORT

                    PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*********************************************************************************************************************
* ROUTE  * MOTOR PCOL      * CCLLECTION      * TRANSPORT       * TO ROUTE,       *                     * AVG WT     * AVG        *
* NUMBER * TO ROUTE        * OPERATION       * OPERATION       * COLLECTION,     * DISCHARGE           * COLLECTED  * LOADS      *
*        * (PER DAY)       * (PER DAY)       * (PER DAY)       * TRANSPORT       * POINT               * (PER DAY)  * (PER DAY)  *
*        *                 *                 *                 * (PER DAY)       *(LOADS PER DAY)      * (TONS)     *            *
*        ******************************************************************************************** *            *            *
*        *                 *                 *                 *                 *        * LAND * XFER *            *            *
*        * MILES * HOURS   * MILES * HOURS   * MILES * HOURS   * MILES * HOURS   * INCIN  * FILL * STA  *            *            *
*********************************************************************************************************************

 04-01      6.4     0.32       9.9    5.24     32.9    2.15      49.2    7.71      0.0     1.5    1.0     13.21         2.5
 04-02      5.3     0.24      11.6    4.64     29.7    1.65      46.6    6.53      0.0     1.4    0.9     11.74         2.3
 04-03      6.6     0.31       9.0    5.03     31.4    2.00      47.0    7.33      0.0     1.4    1.1     12.60         2.4
 04-04      6.7     0.27       9.8    4.33     36.4    1.90      52.9    6.50      0.0     1.4    0.9     12.87         2.3

  SUM      25.1     1.14      40.3   19.24    130.3    7.69     195.7   28.07      0.0     5.6    3.8     50.41         9.4
  AVG       6.3     0.29      10.1    4.81     32.6    1.92      48.9    7.02      0.0     1.4    1.0     12.60         2.4
  YTD       6.3     0.29      10.1    4.81     32.6    1.92      48.9    7.02      0.0     1.4    1.0     12.60         2.4

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 05-01      4.8     0.27      12.7    4.37     28.9    1.67      46.4    6.31      0.0     2.0    0.0     13.67         2.0
 05-02      4.4     0.26      13.9    4.75     30.7    1.63      48.9    6.65      0.0     2.0    0.0     14.54         2.0
 05-03      3.6     0.24      12.9    5.03     28.4    1.78      44.9    7.05      0.0     1.9    0.0     14.74         1.9
 05-04      4.4     0.30      12.8    4.55     31.8    1.90      49.0    6.75      0.0     1.9    0.0     14.62         1.9

  SUM      17.2     1.07      52.3   18.70    119.8    6.99     189.2   26.76      0.0     7.8    0.0     57.97         7.7
  AVG       4.3     0.27      13.1    4.68     29.9    1.75      47.3    6.69      0.0     1.9    0.0     14.49         1.9
  YTD       4.3     0.27      13.1    4.68     29.9    1.75      47.3    6.69      0.0     1.9    0.0     14.49         1.9

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 06-01      2.4     0.15      21.0    4.06     12.0    1.42      35.4    5.63      0.0     0.0    4.3      6.71         4.2
 06-02      2.4     0.15      22.0    4.25     10.9    1.22      35.3    5.63      0.0     0.0    4.3      6.83         4.3
 06-03      2.3     0.17      20.7    4.01     12.6    1.45      35.6    5.64      0.0     0.0    4.5      7.10         4.5
 06-04      2.3     0.20      18.4    4.25     12.3    1.42      33.0    5.87      0.0     0.0    4.6      7.21         4.5

  SUM       9.4     0.67      82.0   16.58     47.9    5.52     139.3   22.77      0.0     0.0   17.7     27.86        17.6
  AVG       2.4     0.17      20.5    4.14     12.0    1.38      34.8    5.69      0.0     0.0    4.4      6.96         4.4
  YTD       2.4     0.17      20.5    4.14     12.0    1.38      34.8    5.69      0.0     0.0    4.4      6.96         4.4

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 07-01      5.0     0.23      11.3    3.77     12.8    0.89      29.0    4.89      0.0     2.0    0.0     11.61         2.0
 07-02      1.9     0.12       8.7    4.40     14.0    1.08      24.7    5.60      0.0     2.3    0.0     13.17         2.3
 07-03      5.5     0.34      11.5    3.81     17.9    1.29      34.9    5.44      0.0     2.1    0.0     12.20         2.1
 07-04      2.5     0.11      10.6    3.64     12.4    0.94      25.5    4.68      0.0     2.5    0.0     13.64         2.5

  SUM      14.8     0.80      42.1   15.62     57.1    4.20     114.0   20.62      0.0     8.9    0.0     50.62         8.9
  AVG       3.7     0.20      10.5    3.91     14.3    1.05      28.5    5.16      0.0     2.2    0.0     12.65         2.2
  YTD       3.7     0.20      10.5    3.91     14.3    1.05      28.5    5.16      0.0     2.2    0.0     12.65         2.2

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                         DATA ACQUISITION AND ANALYSIS PROGRAM
                             DAAP COMPUTER PROGRAM OUTPUT
                           DETAILED ROUTE OPERATIONS REPORT

                      PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
**********************************************************************************************************************
* ROUTE  * MOTOR POOL     * COLLECTION     * TRANSPORT      * TO ROUTE,      *                        *            *           *
* NUMBER * TO ROUTE       * OPERATION      * OPERATION      * COLLECTION,    * DISCHARGE              * AVG WT     * AVG       *
*        * (PER DAY)      * (PER DAY)      * (PER DAY)      * TRANSPORT      * POINT                  * COLLECTED  * LOADS     *
*        ********************************************************* (PER DAY)      *(LOADS PER DAY)        * (PER DAY)  * (PER DAY) *
*        *                *                *                *                ************************** (TONS)     *           *
*        * MILES * HOURS  * MILES * HOURS  * MILES * HOURS  * MILES * HOURS  * INCIN * LAND  * XFER  *            *           *
*        *       *        *       *        *       *        *       *        *       * FILL  * STA   *            *           *
**********************************************************************************************************************

  08-01    1.1     0.17     2.7     5.09    39.1     2.68    42.8     7.94    0.0     1.7     0.0      10.67         1.7
  08-02    0.8     0.10     7.9     4.92    31.6     2.53    40.3     7.55    0.0     1.7     0.0       9.27         1.7
  08-03    1.7     0.27     4.0     4.88    31.8     2.22    37.6     7.38    0.0     1.3     0.0       8.54         1.3
  08-04    0.8     0.17     3.2     4.65    35.3     2.57    39.4     7.39    0.0     1.5     0.0      10.01         1.6

  SUM      4.5     0.71    17.8    19.54   137.8    10.01   160.1    30.26    0.0     6.2     0.1      38.89         6.3
  AVG      1.1     0.18     4.5     4.88    34.4     2.50    40.0     7.57    0.0     1.6     0.0       9.72         1.6
  YTD      1.1     0.18     4.5     4.88    34.4     2.50    40.0     7.57    0.0     1.6     0.0       9.72         1.6

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  09-01   10.0     0.54     8.2     5.23    31.1     1.76    49.3     7.52    0.6     1.4     0.0      12.58         2.0
  09-02    7.4     0.22     8.9     3.62    35.9     1.60    52.2     5.43    0.0     2.5     0.0      14.70         2.5
  09-03    6.2     0.14    12.1     3.93    30.4     1.27    48.6     5.34    0.0     2.5     0.0      16.22         2.5
  09-04   16.8     0.42    12.3     4.74    36.1     1.59    65.2     6.75    1.7     0.6     0.0      12.92         2.3

  SUM     40.4     1.32    41.4    17.52   133.4     6.21   215.2    25.05    2.3     7.1     0.0      56.42         9.4
  AVG     10.1     0.33    10.4     4.38    33.4     1.55    53.8     6.26    0.6     1.8     0.0      14.10         2.3
  YTD     10.1     0.33    10.4     4.38    33.4     1.55    53.8     6.26    0.6     1.8     0.0      14.10         2.3

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  10-01    1.1     0.12     6.6     5.21     7.4     1.01    15.1     6.34    0.0     1.0     0.0       6.07         1.0
  10-02    1.2     0.19     4.9     5.01     5.0     0.87    11.1     6.08    0.0     1.0     0.0       6.14         1.0
  10-03    3.3     0.24     7.3     4.91     6.5     1.05    17.0     6.20    0.0     1.0     0.0       6.34         1.0
  10-04    0.4     0.06     8.6     5.10     5.3     0.99    14.3     6.15    0.0     1.0     0.0       6.17         1.0

  SUM      6.0     0.61    27.4    20.23    24.1     3.93    57.5    24.77    0.0     4.1     0.0      24.72         4.1
  AVG      1.5     0.15     6.9     5.06     6.0     0.98    14.4     6.19    0.0     1.0     0.0       6.18         1.0
  YTD      1.5     0.15     6.9     5.06     6.0     0.98    14.4     6.19    0.0     1.0     0.0       6.18         1.0

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  11-01    2.5     0.19     5.5     5.30    20.4     1.42    28.4     6.91    0.0     2.0     0.0       6.20         2.0
  11-02    1.8     0.16     7.6     5.33    17.0     1.33    26.4     6.81    0.0     2.0     0.0       6.53         2.0
  11-03    2.3     0.13     6.8     5.67    15.1     1.08    24.2     6.87    0.0     1.6     0.0       6.18         1.6
  11-04    2.7     0.20     6.3     5.58    17.9     1.16    27.0     6.96    0.0     2.0     0.0       5.83         2.0

  SUM      9.4     0.68    26.2    21.88    70.4     5.01   106.0    27.56    0.0     7.6     0.0      24.74         7.6
  AVG      2.4     0.17     6.6     5.47    17.6     1.25    26.5     6.89    0.0     1.9     0.0       6.18         1.9
  YTD      2.4     0.17     6.6     5.47    17.6     1.25    26.5     6.89    0.0     1.9     0.0       6.18         1.9

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                                 DATA ACQUISITION AND ANALYSIS PROGRAM
                                     DAAP COMPUTER PROGRAM OUTPUT
                                     COLLECTION ROUTE COST REPORT

                                PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*******************************************************************************************************************************
* ROUTE  * COST TC * COST TO * COST TO  * EQUIP   * MANPOWER* TOTAL   * TOTAL      * TOTAL     * TOTAL     * COST  * COST PER    *
* NUMBER * ROUTE   * COLLECT *TRANSPORT* COST    * COST    * COST    * BREAKDOWN  * INCENTIVE * OVERTIME  * PER   *   HOME      *
*        * PER DAY * PER DAY * PER DAY * PER DAY * PER DAY * PER DAY * COST       * COST      * COST      * TON   * SERVICED    *
*        *         *         *         *         *         *         * (MANPOWER)*           *           *       ************* *
*        *         *         *         *         *         *         *            *           *           *       * WEEK* YEAR*
*******************************************************************************************************************************

  01-01     5.23     50.97     20.92     31.50     45.62     77.13       37.45      3236.20       0.00       8.64    0.19    9.88
  01-02     3.75     51.10     23.08     32.31     45.62     77.93       62.02      2700.51       0.CO       8.43    0.20   10.40
  01-03     4.11     50.58     24.67     33.74     45.62     79.36      200.39      3146.46       0.00       7.94    0.19    9.88
  01-04     4.21     51.60     22.41     32.60     45.62     78.22      130.66      3125.08       0.CO       8.16    0.17    8.84

   SUM     17.30    204.26     91.07    130.15    182.49    312.64      430.53     12208.33       0.00      33.18    0.75   39.00
   AVG      4.32     51.C7     22.77     32.54     45.62     78.16                                           8.29    0.19    9.75
   YTD      4.32     51.07     22.77     32.54     45.62     78.16                                           8.29    0.19    9.88
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  02-01     1.31     54.15     20.98     30.66     45.79     76.45      111.25         0.00       41.23       8.39    0.30   15.60
  02-02     1.63     49.55     24.57     30.63     45.11     75.74       44.86         0.00        8.C4       8.37    0.29   15.08
  02-03     1.40     51.89     22.54     30.73     45.10     75.83       32.77         0.00       31.95       8.38    0.31   16.12
  02-04     2.05     51.41     23.10     30.79     45.76     76.55       47.28         0.00       26.58       8.72    0.29   15.08

   SUM      6.38    207.00     91.19    122.81    181.75    304.57      236.15         0.00      107.81      33.86    1.19   61.88
   AVG      1.60     51.75     22.80     30.70     45.44     76.14                                           8.46    0.30   15.47
   YTD      1.60     51.75     22.80     30.70     45.44     76.14                                           8.46    0.30   15.60
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  03-01     4.44     60.45     12.28     31.55     45.62     77.17       30.17      2948.96       0.00      14.08    0.36   18.72
  03-02     4.64     58.92     13.63     31.56     45.62     77.19       26.69      2755.92       0.CO      13.41    0.38   19.76
  03-03     4.82     58.76     13.70     31.66     45.62     77.28      136.54      3155.21       0.00      13.53    0.34   17.68
  03-04     3.90     6C.54     12.79     31.61     45.62     77.23      106.49      2757.35       0.CO      12.92    0.42   21.84

   SUM     17.81    238.66     52.41    126.38    182.49    308.87      299.90     11617.43       0.00      53.94    1.50   78.00
   AVG      4.45     59.66     13.10     31.60     45.62     77.22                                          13.48    0.37   19.50
   YTD      4.45     59.66     13.10     31.60     45.62     77.22                                          13.48    0.37   19.24
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                              DATA ACQUISITION AND ANALYSIS PROGRAM
                                  DAAP COMPUTER PROGRAM OUTPUT
                                  COLLECTION ROUTE COST REPORT

                          PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*************************************************************************************************************************
*         *         *         *          *         *         *         *          *          *          *       *              *
* ROUTE   * COST TO * COST TO * COST TO  * EQUIP   * MANPOWER* TOTAL   * TOTAL    * TOTAL    * TOTAL    * COST  * COST PER     *
* NUMBER  * ROUTE   * COLLECT *TRANSPORT * COST    * COST    * COST    * BREAKDOWN* INCENTIVE* OVERTIME * PER   *   HOME       *
*         * PER DAY * PER DAY * PER DAY  * PER DAY * PER DAY * PER DAY * COST     * COST     * COST     * TON   * SERVICED     *
*         *         *         *          *         *         *         * (MANPOWER)*         *          *       ************** *
*         *         *         *          *         *         *         *          *          *          *       * WEEK* YEAR*
*************************************************************************************************************************

  04-01       5.01     81.83     33.53      30.91     69.47    120.37      88.57    1885.78       0.00      9.11    0.23   11.96
  04-02       4.45     84.86     30.19      30.28     69.25    119.53     144.86    3674.53       0.00     10.18    0.23   11.96
  04-03       4.99     82.27     32.67      30.68     69.25    119.93     123.71    2323.38       0.00      9.52    0.23   11.96
  04-04       5.03     79.95     35.05      30.78     69.25    120.03     153.28    3039.63       0.00      9.33    0.23   11.96

   SUM       19.49    328.93    131.43     122.64    357.21    479.85     510.43   11723.33       0.00     38.15    0.92   47.84
   AVG        4.87     82.23     32.86      30.66     69.30    119.96                                        9.54    0.23   11.96
   YTD        4.87     82.23     32.86      30.66     69.30    119.96                                        9.54    0.23   11.96

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  05-01       5.27     85.82     32.87      31.49     92.46    123.95     318.20       0.00     293.10      9.07    0.22   11.44
  05-02       4.94     69.37     30.64      31.85     93.11    124.96     174.61       0.00     375.01      8.36    0.19    9.88
  05-03       4.41     92.13     32.52      31.54     97.52    129.06     128.49       0.00     465.01      8.75    0.23   11.96
  05-04       5.64     85.64     35.89      31.85     95.31    127.17     180.75       0.00     358.94      8.70    0.22   11.44

   SUM       20.26    352.96    131.92     126.74    378.40    505.14     802.26       0.00    1492.06     34.68    0.86   44.72
   AVG        5.07     88.24     32.98      31.68     94.60    126.28                                        8.72    0.21   11.18
   YTD        5.07     88.24     32.98      31.68     94.60    126.28                                        8.72    0.22   11.44

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  06-01       3.95    107.03     37.55      43.70    104.84    148.54     302.43    5714.23       0.00     22.12    0.54   28.08
  06-02       3.93    110.53     31.76      43.66    102.56    146.22     205.19    5662.88       0.00     21.40    0.53   27.56
  06-03       4.53    104.41     37.72      43.74    102.92    146.66     169.24    5246.53       0.00     20.64    0.53   27.56
  06-04       4.93    106.57     35.75      43.66    103.59    147.25     251.97    5083.75       0.00     20.43    0.45   23.40

   SUM       17.34    428.55    142.78     174.77    413.91    588.68     928.83   21707.39       0.00     84.60    2.05  106.60
   AVG        4.34    107.14     35.70      43.69    103.48    147.17                                       21.15    0.51   26.65
   YTD        4.34    107.14     35.70      43.69    103.48    147.17                                       21.15    0.51   26.52

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  07-01       7.61    124.57     29.39      28.69    132.87    161.56      39.21   12756.37       0.00     13.92    0.41   21.32
  07-02       3.58    126.89     31.03      28.63    132.87    161.50      63.94    9938.68       0.00     12.26    0.38   19.76
  07-03      10.01    113.28     38.45      28.87    132.87    161.74      65.11   10459.37       0.00     13.26    0.39   20.28
  07-04       3.81    125.34     32.32      28.60    132.87    161.47      90.63   13726.05       0.00     11.64    0.40   20.80

   SUM       25.01    490.08    131.19     114.79    531.49    646.27     258.88   46880.46       0.00     51.28    1.58   82.16
   AVG        6.25    122.52     32.80      28.70    132.87    161.57                                       12.82    0.39   20.54
   YTD        6.25    122.52     32.80      28.70    132.87    161.57                                       12.82    0.39   20.28

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                                    DATA ACQUISITION AND ANALYSIS PROGRAM
                                        DAAP COMPUTER PROGRAM OUTPUT
                                        COLLECTION ROUTE COST REPORT

                                 PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
•         •          •          •           •          •           •          •            •           •           •          •             •
• ROUTE   • COST TO  • COST TO  • COST TO   • EQUIP    • MANPOWER• TOTAL      • TOTAL      • TOTAL     • TOTAL     • COST     • COST PER    •
• NUMBER  • ROUTE    • COLLECT  •TRANSPORT• • COST     • COST      • COST     • BREAKDOWN  • INCENTIVE • OVERTIME  • PER      •    HOME     •
•         • PER DAY  • PER DAY  • PER DAY   • PER DAY  • PER DAY   • PER DAY  • COST       • COST      • COST      • TON      • SERVICED    •
•         •          •          •           •          •           •          • (MANPOWER)•           •           •          •••••••••••••••
•         •          •          •           •          •           •          •            •           •           •          • WEEK• YEAR•
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

  08-01       3.66     108.98      57.43       32.48     137.58     170.06        292.61        0.00     1168.54     15.94     0.48    24.96
  08-02       2.14     104.56      53.83       24.37     136.14     160.51        328.96        0.00      747.34     17.31     0.69    35.88
  08-03       6.10     109.46      49.84       32.03     133.37     165.40        393.57        0.00      113.76     18.50     0.50    26.00
  08-04       3.81     105.58      58.44       31.83     136.01     167.83        450.07        0.00      774.69     16.76     0.53    27.56

   SUM       15.70     428.57     219.54      120.71     543.09     663.80       1465.20        0.00     2804.32     68.52     2.20   114.40
   AVG        3.93     107.14      54.88       30.18     135.77     165.95                                           17.13     0.55    28.60
   YTD        3.93     107.14      54.88       30.18     135.77     165.95                                           17.13     0.55    28.60
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

  09-01      14.66     142.27      47.87       38.71     166.09     204.80         89.76     8539.42        0.00     16.28     0.48    24.96
  09-02       8.14     136.55      60.40       38.74     166.35     205.09        121.96    15583.10        0.00     13.95     0.47    24.44
  09-03       5.31     150.54      48.51       36.96     167.40     204.36        145.93    15999.46        0.00     12.60     0.42    21.84
  09-04      12.86     143.95      48.11       38.30     166.62     204.92        203.55    10676.74        0.00     15.86     0.55    28.60

   SUM       40.96     573.31     204.90      152.71     666.46     819.17        561.21    50798.71        0.00     58.70     1.92    99.84
   AVG       10.24     143.33      51.23       38.18     166.62     204.79                                           14.67     0.48    24.96
   YTD       10.24     143.33      51.23       38.18     166.62     204.79                                           14.67     0.48    24.96
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

  10-01       2.20      97.51      18.94       28.73      89.92     118.65         33.33     4632.72        0.00     19.55     0.32    16.64
  10-02       3.77      97.46      16.99       28.64      89.58     118.23          9.79     5472.80        0.00     19.26     0.32    16.64
  10-03       4.59      93.53      20.05       28.76      89.42     118.18         19.42     4869.00        0.00     18.64     0.33    17.16
  10-04       1.19     100.43      19.52       28.83      92.31     121.14         18.72     5265.68        0.00     19.67     0.32    16.64

   SUM       11.76     388.93      75.50      114.96     361.24     476.19         81.27    20240.21        0.00     77.07     1.29    67.08
   AVG        2.94      97.23      18.88       28.74      90.31     119.05                                           19.27     0.32    16.77
   YTD        2.94      97.23      18.88       28.74      90.31     119.05                                           19.27     0.32    16.64
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

  11-01       3.14      86.08      23.10       22.83      89.48     112.31        100.67        0.00       12.76     18.12     0.42    21.84
  11-02       2.63      87.70      21.80       22.33      89.81     112.13         84.78        0.00        0.00     17.17     0.47    24.44
  11-03       2.20      97.33      18.53       28.53      89.52     118.05         64.76        0.00       22.33     19.11     0.49    25.48
  11-04       3.17      89.90      19.08       22.25      89.91     112.16         93.56        0.00       27.76     19.24     0.48    24.96

   SUM       11.13     361.01      82.51       95.94     358.71     454.65        343.78        0.00       62.85     73.63     1.86    96.72
   AVG        2.78      90.25      20.63       23.98      89.68     113.66                                           18.41     0.46    24.18
   YTD        2.78      90.25      20.63       23.98      89.68     113.66                                           18.41     0.47    24.44
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
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                              DATA ACQUISITION AND ANALYSIS PROGRAM
                                  DAAP COMPUTER PROGRAM OUTPUT
                               COLLECTION CREW PRODUCTIVITY REPORT

                            PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*******************************************************************************************************************
*        *                *                      *              *            * CREW PRODUCTIVITY  * COLLECTOR PRODUCTIVITY             *       *
* ROUTE  *     HOMES      * AVERAGE WEIGHT       * COLLECT      * COLLECT    ***********************************************************       *
*        *     SERVED     * COLLECTED PER HOME*  * TIME PER     * TIME       * HOMES      * WEIGHT       *HOMES SERVED    *WEIGHT          *INDEX  *
* NUMBER ***************************************** HOME PER     * PER        * SERVED     * HANDLED      *PER COLLECTOR   *HANDLED PER     *  OF   *
*        * PER   * PER    * PER       * PER      * COLLECTION*  * 100 LBS.*  * PER        * PER          *PER COLLECTION*COLLECTOR PER*PRODUCT-*
*        * DAY   * WEEK   * COLLECT-* * WEEK     * (MINUTES)  * * (MINS)     *COLLECTION*COLLECTION*HOUR             *COLLECTION      *IVITY  *
*        *       *        * ION(LBS)* * (LBS)    *              *            * HOUR       *HOUR(TONS)*                  *HOUR(TONS)      *       *
*******************************************************************************************************************

  01-01    392.   1962.     45.5       45.5       0.58         1.27        104.1        2.4          104.1          2.4          161.30
  01-02    375.   1874.     49.3       49.3       0.65         1.32         92.3        2.3           92.3          2.3          150.68
  01-03    415.   2077.     48.1       48.1       0.53         1.10        113.1        2.7          113.1          2.7          170.27
  01-04    459.   2294.     41.8       41.8       0.50         1.20        119.5        2.5          119.5          2.5          173.64

   SUM    1641.   8207.    184.7      184.7       2.26         4.89        429.1        9.9          429.1          9.9          655.90
   AVG     410.   2052.     46.2       46.2       0.56         1.22        107.3        2.5          107.3          2.5          163.97
   YTD     410.   2052.     46.2       46.2       0.56         1.22        107.3        2.5          107.3          2.5          163.97
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  02-01    249.   1247.     73.1       73.1       1.15         1.57         52.4        1.9           52.4          1.9          134.31
  02-02    259.   1295.     69.9       69.9       1.03         1.47         58.3        2.0           58.3          2.0          135.00
  02-03    244.   1222.     74.0       74.0       1.10         1.49         54.5        2.0           54.5          2.0          134.98
  02-04    261.   1307.     67.1       67.1       1.04         1.56         57.5        1.9           57.5          1.9          127.03

   SUM    1014.   5072.    284.1      284.1       4.32         6.08        222.7        7.9          222.7          7.9          531.33
   AVG     254.   1268.     71.0       71.0       1.08         1.52         55.7        2.0           55.7          2.0          132.83
   YTD     254.   1268.     71.0       71.0       1.08         1.52         55.7        2.0           55.7          2.0          132.83
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  03-01    424.   1272.     25.9       51.7       0.70         2.70         85.9        1.1           85.9          1.1          125.65
  03-02    402.   1207.     28.6       57.2       0.73         2.56         82.0        1.2           82.0          1.2          122.34
  03-03    448.   1344.     25.5       51.0       0.63         2.46         95.6        1.2           95.6          1.2          134.79
  03-04    366.   1099.     32.6       65.3       0.62         2.51         73.2        1.2           73.2          1.2          121.50

   SUM    1641.   4922.    112.6      225.2       2.88        10.23        336.7        4.7          336.7          4.7          504.29
   AVG     410.   1231.     28.2       56.3       0.72         2.56         84.2        1.2           84.2          1.2          126.07
   YTD     410.   1231.     28.2       56.3       0.72         2.56         84.2        1.2           84.2          1.2          126.07
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                         DATA ACQUISITION AND ANALYSIS PROGRAM
                              DAAP COMPUTER PROGRAM OUTPUT
                         COLLECTION CREW PRODUCTIVITY REPORT

                      PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*****************************************************************************************************************
*        *                *                          *              *            * CREW PRODUCTIVITY           * COLLECTOR PRODUCTIVITY        *            *
* ROUTE  *     HOMES      * AVERAGE WEIGHT           * COLLECT      * COLLECT    ***********************************************************              *
*        *     SERVED     * COLLECTED PER HOME       * TIME PER     * TIME       * HOMES        * WEIGHT       *HOMES SERVED  *WEIGHT        *INDEX       *
* NUMBER ******************************************** HOME PER     * PER        * SERVED       * HANDLED      *PER COLLECTOR *HANDLED PER   * OF         *
*        * PER   * PER    * PER        * PER         * COLLECTION   * 100 LBS.   * PER          * PER          *PER COLLECTION*COLLECTOR PER *PRODUCT-    *
*        * DAY   * WEEK   * COLLECT-   * WEEK        * (MINUTES)    * (MINS)     *COLLECTION    *COLLECTION    *HOUR          *COLLECTION    *IVITY       *
*        *       *        * ION(LBS)   * (LBS)       *              *            * HOUR         *HOUR(TONS)    *              *HOUR(TONS)    *            *
*****************************************************************************************************************

  04-01     510.  2549.       51.8        51.8        0.62        1.19      97.3       2.5       96.8       2.5      159.04
  04-02     510.  2548.       46.1        46.1        0.55        1.19     109.9       2.5      109.9       2.5      167.55
  04-03     514.  2572.       49.0        49.0        0.59        1.20     102.2       2.5      102.2       2.5      160.22
  04-04     515.  2575.       50.0        50.0        0.50        1.01     118.9       3.0      118.9       3.0      178.68

   SUM     2049. 10244.      196.8       196.8        2.25        4.58     428.3      10.5      427.8      10.5      665.49
   AVG      512.  2561.       49.2        49.2        0.56        1.15     107.1       2.6      107.0       2.6      166.37
   YTD      512.  2561.       49.2        49.2        0.56        1.15     107.1       2.6      107.0       2.6      166.37

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  05-01     549.  2744.       49.8        49.8        0.48        0.96     125.6       3.1      121.8       3.0      188.10
  05-02     633.  3163.       47.2        47.2        0.45        0.95     133.1       3.1      128.4       3.0      194.16
  05-03     559.  2796.       52.7        52.7        0.54        1.02     111.1       2.9       98.7       2.6      176.74
  05-04     561.  2805.       52.1        52.1        0.49        0.93     123.4       3.2      113.2       3.0      168.32

   SUM     2302. 11508.      201.9       201.9        1.95        3.87     493.2      12.4      462.1      11.6      747.32
   AVG      575.  2877.       50.5        50.5        0.49        0.97     123.3       3.1      115.5       2.9      186.83
   YTD      575.  2877.       50.5        50.5        0.49        0.97     123.3       3.1      115.5       2.9      186.83

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  06-01     544.  1088.       24.7        49.4        0.45        1.81     134.0       1.7      125.7       1.6      179.69
  06-02     549.  1098.       24.9        49.8        0.47        1.87     129.0       1.6      126.4       1.6      175.87
  06-03     549.  1098.       25.9        51.8        0.44        1.70     136.7       1.8      133.0       1.7      183.27
  06-04     653.  1306.       22.1        44.1        0.39        1.77     153.8       1.7      147.7       1.6      194.22

   SUM     2295.  4589.       97.5       195.1        1.74        7.14     553.5       6.7      532.8       6.5      733.05
   AVG      574.  1147.       24.4        48.8        0.44        1.79     138.4       1.7      133.2       1.6      183.26
   YTD      574.  1147.       24.4        48.8        0.44        1.79     138.4       1.7      133.2       1.6      183.26

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  07-01     391.  1956.       59.4        59.4        0.56        0.98     103.6       3.1       51.8       1.5      174.32
  07-02     424.  2120.       62.1        62.1        0.62        1.00      96.4       3.0       48.2       1.5      167.19
  07-03     408.  2042.       59.7        59.7        0.56        0.94     107.2       3.2       53.6       1.6      178.39
  07-04     403.  2017.       67.6        67.6        0.54        0.80     111.0       3.8       55.5       1.9      189.19

   SUM     1627.  8136.      248.8       248.8        2.30        3.71     418.2      13.0      209.1       6.5      709.08
   AVG      407.  2034.       62.2        62.2        0.58        0.93     104.5       3.3       52.3       1.6      177.27
   YTD      407.  2034.       62.2        62.2        0.58        0.93     104.5       3.3       52.3       1.6      177.27

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                              DATA ACQUISITION AND ANALYSIS PROGRAM
                                   DAAP COMPUTER PROGRAM OUTPUT
                              COLLECTION CREW PRODUCTIVITY REPORT

                           PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*********************************************************************************************************************************
*         *                 *                           *              *             * CREW PRODUCTIVITY  * COLLECTOR PRODUCTIVITY     *            *
* ROUTE   *      HOMES      * AVERAGE WEIGHT            * COLLECT      * COLLECT     ********************************************************            *
*         *      SERVED     * COLLECTED PER HOME        * TIME PER     * TIME        * HOMES        * WEIGHT       *HOMES SERVED   *WEIGHT             *INDEX      *
* NUMBER  ************************************************* HOME PER     * PER         * SERVED       * HANDLED      *PER COLLECTOR  *HANDLED PER        *  OF       *
*         * PER    * PER    * PER          * PER          * COLLECTION   * 100 LBS.    * PER          * PER          *PER COLLECTION *COLLECTOR PER      *PRODUCT-   *
*         * DAY    * WEEK   * COLLECT-     * WEEK         * (MINUTES)    * (MINS)      *COLLECTION    *COLLECTION    *HOUR           *COLLECTION         *IVITY      *
*         *        *        * ION(LBS)     * (LBS)        *              *             * HOUR         *HOUR(TONS)    *               *HOUR(TONS)         *           *
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  08-01      349.   1746.       61.1          61.1          0.87          1.43          68.7          2.1           34.4           1.1          132.41
  08-02      229.   1147.       80.9          80.9          1.29          1.59          46.6          1.9           23.3           0.9          135.43
  08-03      331.   1653.       54.1          54.1          0.69          1.64          67.7          1.8           33.9           0.9          125.86
  08-04      316.   1580.       63.4          63.4          0.68          1.39          67.9          2.2           34.0           1.1          134.48

   SUM      1225.   6125.      259.4         259.4          3.93          6.05         250.9          8.0          125.6           4.0          528.16
   AVG       306.   1531.       64.9          64.9          0.98          1.51          62.7          2.0           31.4           1.0          132.04
   YTD       306.   1531.       64.9          64.9          0.98          1.51          62.7          2.0           31.4           1.0          132.04

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  09-01      847.   1694.       29.7          59.4          0.37          1.25         162.0          2.4           81.0           1.2          199.92
  09-02      862.   1724.       34.1          68.2          0.25          0.74         238.4          4.1          118.9           2.0          281.33
  09-03      962.   1925.       33.7          67.4          0.25          0.73         244.9          4.1          121.0           2.0          290.68
  09-04      744.   1487.       34.7          69.5          0.38          1.10         156.7          2.7           78.0           1.4          203.73

   SUM      3415.   6830.      132.3         264.5          1.25          3.81         802.0         13.3          398.9           6.6          975.66
   AVG       854.   1707.       33.1          66.1          0.31          0.95         200.5          3.3           99.7           1.7          243.92
   YTD       854.   1707.       33.1          66.1          0.31          0.95         200.5          3.3           99.7           1.7          243.91

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  10-01      368.   1838.       33.0          33.0          0.65          2.57          70.6          1.2           69.5           1.1          110.24
  10-02      365.   1827.       33.6          33.6          0.82          2.45          73.0          1.2           72.4           1.2          111.46
  10-03      357.   1786.       35.5          35.5          0.82          2.32          72.8          1.3           72.5           1.3          115.51
  10-04      367.   1837.       33.6          33.6          0.83          2.46          72.0          1.2           67.3           1.1          114.27

   SUM      1458.   7288.      135.7         135.7          3.33          9.82         288.3          4.9          281.7           4.8          451.48
   AVG       364.   1822.       33.9          33.9          0.83          2.46          72.1          1.2           70.4           1.2          112.87
   YTD       364.   1822.       33.9          33.9          0.83          2.46          72.1          1.2           70.4           1.2          112.87

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  11-01      266.   1330.       46.6          46.6          1.19          2.56          50.2          1.2           50.0           1.2          102.27
  11-02      234.   1168.       55.9          55.9          1.37          2.45          43.8          1.2           43.3           1.2          107.32
  11-03      240.   1198.       51.6          51.6          1.42          2.75          42.3          1.1           42.1           1.1          100.70
  11-04      231.   1155.       50.5          50.5          1.45          2.87          41.4          1.0           40.9           1.0           98.20

   SUM       970.   4852.      204.5         204.5          5.43         10.64         177.7          4.5          176.3           4.5          408.48
   AVG       243.   1213.       51.1          51.1          1.36          2.66          44.4          1.1           44.1           1.1          102.12
   YTD       243.   1213.       51.1          51.1          1.36          2.66          44.4          1.1           44.1           1.1          102.12

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                                   DATA ACQUISITION AND ANALYSIS PROGRAM
                                       DAAP COMPUTER PROGRAM OUTPUT
                                    COLLECTION SYSTEM EFFICIENCY REPORT

                                PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
*****************************************************************************************************************
*       *        *            *          *          *                          *          *                    *         *              *
*ROUTE  * RATIO  * RATIO      * RATIO    * RATIO    *COLLECTION RELATED COSTS* WEIGHT   *     AVERAGE        * WEIGHT  * INDEX OF     *
*       * WORK   *COLLECTION* EQUIP    * MANPOWER*                          * HANDLED  * WEIGHT PER LOAD* PER CU.* ROUTE        *
*NUMBER* TIME   * TIME       * COST     * COST TO  ************************** PER      *      (TONS)        * YARD    * EFFICIENCY   *
*       * TO     * TO         * TO       * TOTAL    *COLLECTION  *COLLECTION  * COLLECTOR******************** FIRST   *              *
*       * STD.   * TIME       * MANPOWER* COST     *COST PER    *COST PER TON* PER DAY  * FIRST    * ALL     * LOAD    *              *
*       * TIME   * WORKED     * COST     *          *HOME SERVED*COLLECTED   * (TONS)   * LOAD     * OTHERS*(POUNDS)*              *
*****************************************************************************************************************

  01-01   0.72     0.66        0.69       0.59      0.13        5.71        8.93      6.08     3.38      486.6      316.44
  01-02   0.78     0.65        0.71       0.59      0.14        5.53        9.24      6.65     3.66      531.9      294.86
  01-03   0.73     0.63        0.74       0.57      0.12        5.06        9.53      6.73     4.49      538.4      336.62
  01-04   0.74     0.65        0.71       0.56      0.11        5.38        9.59      6.26     4.25      500.9      336.50

  SUM     2.96     2.59        2.85       2.34      0.50       21.69       37.74     25.72    15.78     2057.8     1284.41
  AVG     0.74     0.65        0.71       0.58      0.13        5.42        9.44      6.43     3.95      514.5      321.10
  YTD     0.74     0.65        0.71       0.58      0.13        5.42        9.44      6.43     3.95      514.5      321.10

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  02-01   0.85     0.70        0.67       0.60      0.22        5.94        9.12      6.29     5.21      503.0      248.03
  02-02   0.85     0.65        0.68       0.60      0.19        5.47        9.05      5.90     4.60      472.4      272.47
  02-03   0.82     0.68        0.68       0.59      0.21        5.73        9.05      5.85     5.12      467.7      260.14
  02-04   0.85     0.67        0.67       0.60      0.20        5.86        8.78      5.67     4.68      453.0      247.11

  SUM     3.37     2.70        2.70       2.39      0.82       23.01       35.99     23.72    19.61     1896.1     1027.74
  AVG     0.84     0.68        0.68       0.60      0.20        5.75        9.00      5.93     4.90      474.0      256.94
  YTD     1.00     0.68        0.66       0.60      0.20        5.75        9.00      5.93     4.90      474.0      256.94

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  03-01   0.79     0.78        0.69       0.59      0.14       11.03        5.48      5.47     4.08      331.9      207.86
  03-02   0.81     0.76        0.69       0.59      0.15       10.24        5.76      5.71     3.09      346.7      207.65
  03-03   0.78     0.75        0.69       0.59      0.13       10.29        5.71      5.68     3.62      344.5      229.41
  03-04   0.80     0.78        0.69       0.59      0.17       10.13        5.98      5.88     2.88      356.5      200.71

  SUM     3.18     3.07        2.77       2.36      0.59       41.68       22.93     22.74    13.65     1379.5      845.64
  AVG     0.79     0.77        0.69       0.59      0.15       10.42        5.73      5.69     3.41      344.9      211.41
  YTD     0.79     0.77        0.69       0.59      0.15       10.42        5.73      5.69     3.41      344.9      211.41

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                              DATA ACQUISITION AND ANALYSIS PROGRAM
                                  DAAP COMPUTER PROGRAM OUTPUT
                               COLLECTION SYSTEM EFFICIENCY REPORT

                          PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
***********************************************************************************************************************
*        *          *           *          *          *                           *           *                  *           *           *
*ROUTE   * RATIO    * RATIO     * RATIO    * RATIO    *COLLECTION RELATED COSTS* WEIGHT      *                  * WEIGHT    * INDEX OF  *
*        * WORK     *COLLECTION* EQUIP    * MANPOWER*                           * HANDLED     *     AVERAGE      * PER CU.*  * ROUTE     *
*NUMBER* * TIME     * TIME      * COST     * COST TO *************************** PER         * WEIGHT PER LOAD* * YARD      * EFFICIENCY*
*        * TO       * TO        * TO       * TOTAL    *COLLECTION  *COLLECTION   * COLLECTOR   *     (TONS)       * FIRST     *           *
*        * STD.     * TIME      * MANPOWER* COST     *COST PER    *COST PER TON* PER DAY     ******************** LOAD      *           *
*        * TIME     * WORKED    * COST     *          *HOME SERVED*COLLECTED    * (TONS)      * FIRST  * ALL     *(POUNDS)*  *           *
*        *          *           *          *          *            *             *             * LOAD   * OTHERS  *           *           *
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  04-01   0.97      0.67        0.35       0.74       0.16          6.20          13.14        5.99    4.96       599.0      194.35
  04-02   0.83      0.70        0.34       0.75       0.17          7.23          11.74        5.71    4.73       572.1      197.39
  04-03   0.93      0.68        0.34       0.74       0.16          6.53          12.60        5.77    4.84       577.2      194.76
  04-04   0.83      0.65        0.34       0.74       0.16          6.21          12.87        6.22    5.14       622.4      223.50

  SUM     3.56      2.70        1.37       2.98       0.64         26.17          50.34       23.69   19.66      2370.7      809.99
  AVG     0.89      0.68        0.34       0.74       0.16          6.54          12.59        5.92    4.92       592.7      202.50
  YTD     0.89      0.68        0.34       0.74       0.16          6.54          12.59        5.92    4.92       592.7      202.50
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  05-01   0.86      0.64        0.34       0.75       0.16          6.28          13.26        8.13    5.80       687.6      219.19
  05-02   0.89      0.67        0.34       0.75       0.14          5.98          14.42        8.98    6.00       738.5      217.26
  05-03   0.90      0.70        0.32       0.76       0.16          6.25          13.10        9.67    5.68       776.7      191.84
  05-04   0.87      0.65        0.33       0.75       0.15          5.86          13.41        9.27    5.91       774.3      219.89

  SUM     3.52      2.66        1.34       3.00       0.62         24.37          54.18       36.06   23.38      2977.1      848.17
  AVG     0.88      0.66        0.34       0.75       0.15          6.09          13.55        9.02    5.85       744.3      212.04
  YTD     1.00      0.66        0.34       0.75       0.15          6.09          13.55        9.02    5.85       744.3      212.04
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  06-01   0.73      0.70        0.42       0.71       0.20         15.94           6.30        1.57    1.58       392.9      167.88
  06-02   0.72      0.74        0.43       0.70       0.20         16.18           6.70        1.57    1.59       392.7      159.11
  06-03   0.72      0.70        0.43       0.70       0.19         14.70           6.91        1.56    1.57       389.5      175.52
  06-04   0.75      0.71        0.42       0.70       0.16         14.79           6.92        1.56    1.59       389.3      182.25

  SUM     2.92      2.84        1.69       2.81       0.75         61.60          26.83        6.26    6.33      1564.5      684.76
  AVG     0.73      0.71        0.42       0.70       0.19         15.40           6.71        1.56    1.58       391.1      171.19
  YTD     0.73      0.71        0.42       0.70       0.19         15.40           6.71        1.56    1.58       391.1      171.19
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  07-01   0.62      0.76        0.22       0.82       0.32         10.73           5.80        6.97    4.66       700.5      139.94
  07-02   0.71      0.78        0.22       0.82       0.30          9.64           6.58        6.44    5.11       642.1      131.76
  07-03   0.69      0.69        0.22       0.82       0.28          9.28           6.10        6.66    4.84       666.5      157.48
  07-04   0.59      0.77        0.22       0.82       0.31          9.19           6.82        6.38    4.94       638.5      150.93

  SUM     2.60      3.00        0.86       3.29       1.21         38.84          25.31       26.45   19.54      2647.6      580.11
  AVG     0.65      0.75        0.22       0.82       0.30          9.71           6.33        6.61    4.89       661.9      145.03
  YTD     0.65      0.75        0.22       0.82       0.30          9.71           6.33        6.61    4.89       661.9      145.03
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                         DATA ACQUISITION AND ANALYSIS PROGRAM
                              DAAP COMPUTER PROGRAM OUTPUT
                          COLLECTION SYSTEM EFFICIENCY REPORT

                     PERIOD FOR WHICH DATA APPLIES JANUARY-DECEMBER
**********************************************************************************************************
*       *        *            *          *          *                              *           *                     *         *              *
*ROUTE  * RATIO  * RATIO      * RATIO    * RATIO    *COLLECTION RELATED COSTS* WEIGHT    *     AVERAGE         * WEIGHT  * INDEX OF     *
*       * WORK   *COLLECTION* EQUIP    * MANPOWER*                              * HANDLED   * WEIGHT PER LOAD* PER CU.* ROUTE        *
*NUMBER* TIME   * TIME       * COST     * COST TO  ****************************** PER       *      (TONS)        * YARD    * EFFICIENCY   *
*       * TO     * TO         * TO       * TOTAL    *COLLECTION  *COLLECTION  * COLLECTOR********************* FIRST   *              *
*       * STD.   * TIME       * MANPOWER* COST     *COST PER    *COST PER TON* PER DAY   * FIRST    * ALL     * LOAD    *              *
*       * TIME   * WORKED     * COST     *          *HOME SERVED*COLLECTED   * (TONS)    * LOAD     * OTHERS*(POUNDS)*              *
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  08-01   1.02     0.62        0.24       0.81       0.31         10.22          5.34      6.27    6.18      511.7      121.50
  08-02   0.97     0.63        0.18       0.85       0.46         11.27          4.64      5.47    5.41      591.9      129.54
  08-03   0.96     0.64        0.24       0.81       0.33         12.24          4.47      5.97    9.27      486.4      114.98
  08-04   0.97     0.60        0.23       0.81       0.33         10.55          5.02      6.19    6.49      508.9      127.37

  SUM     3.92     2.49        0.89       3.27       1.43         44.28         19.47     23.90   27.36     2098.9      493.39
  AVG     0.98     0.62        0.22       0.82       0.36         11.07          4.87      5.98    6.84      524.7      123.35
  YTD     1.00     0.62        0.22       0.82       0.36         11.07          4.87      5.98    6.84      524.7      123.35

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  09-01   0.76     0.69        0.23       0.81       0.17         11.31          6.29      7.05    5.50      704.3      140.52
  09-02   0.55     0.66        0.23       0.81       0.16          9.29          7.33      6.57    5.30      657.3      206.03
  09-03   0.54     0.73        0.22       0.82       0.16          9.28          8.02      7.32    5.75      731.8      193.09
  09-04   0.69     0.69        0.23       0.81       0.19         11.14          6.43      6.77    4.83      677.7      141.53

  SUM     2.54     2.76        0.92       3.25       0.68         41.02         28.06     27.71   21.38     2771.0      681.17
  AVG     0.63     0.69        0.23       0.81       0.17         10.26          7.02      6.93    5.35      692.8      170.29
  YTD     0.63     0.69        0.23       0.81       0.17         10.26          7.02      6.93    5.35      692.8      170.29

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  10-01   0.80     0.81        0.32       0.76       0.27         16.07          5.98      6.01    3.27      600.5      113.05
  10-02   0.76     0.82        0.32       0.76       0.27         15.88          6.09      6.12    1.69      611.7      114.36
  10-03   0.79     0.78        0.32       0.76       0.26         14.75          6.32      6.29    3.09      629.3      123.50
  10-04   0.76     0.82        0.31       0.76       0.27         16.27          5.77      6.14    1.46      614.0      113.78

  SUM     3.13     3.23        1.27       3.03       1.07         62.97         24.15     24.55    9.52     2455.5      464.70
  AVG     0.78     0.81        0.32       0.76       0.27         15.74          6.04      6.14    2.38      613.9      116.17
  YTD     0.78     0.81        0.32       0.76       0.27         15.74          6.04      6.14    2.38      613.9      116.17

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  11-01   0.87     0.76        0.26       0.80       0.32         13.89          6.17      3.76    2.42      554.2      118.81
  11-02   0.86     0.78        0.25       0.80       0.38         13.43          6.45      3.62    2.93      549.9      122.37
  11-03   0.86     0.82        0.32       0.76       0.41         15.75          6.15      4.44    2.76      458.4      103.46
  11-04   0.88     0.79        0.25       0.80       0.39         15.42          5.76      3.61    2.30      525.7      109.22

  SUM     3.48     3.15        1.07       3.16       1.49         58.49         24.53     15.43   10.41     2088.2      453.67
  AVG     0.87     0.79        0.27       0.79       0.37         14.62          6.13      3.86    2.60      522.0      113.47
  YTD     0.96     0.79        0.27       0.79       0.37         14.62          6.13      3.86    2.60      522.0      113.47

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APPENDIX 3
SUMMARY TIME MOTION AND BACKYARD SURVEY REPORTS

SALT LAKE COUNTY   SYSTEM NUMBER 1   ROUTE(1/1-4) 4TH QUARTER 5/22-25/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE				NUMBER OF RETURN-ABLE ITEMS	NUMBER OF NON RETURN-ABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
				CANS	SMALL CANS	BAGS	MISCEL-LANEOUS				
1	1-1	184.	186.	489.	32.	282.	105.	521.	387.	908.	4.60
1	1-2	198.	212.	458.	26.	232.	165.	484.	397.	881.	5.15
1	1-3	169.	174.	429.	28.	213.	119.	457.	332.	789.	3.40
1	1-4	223.	226.	469.	23.	359.	162.	492.	521.	1013.	4.35
SUM		774.	798.	1845.	109.	1086.	551.	1954.	1637.	3591.	17.50
AVERAGE		193.	199.	461.	27.	271.	138.	488.	409.	898.	4.37
2	1-1	174.	179.	473.	21.	244.	95.	494.	339.	833.	4.65
2	1-2	195.	196.	429.	12.	248.	118.	441.	366.	807.	4.90
2	1-3	233.	236.	444.	19.	336.	151.	463.	487.	950.	8.35
2	1-4	223.	223.	415.	23.	243.	126.	438.	369.	807.	4.80
SUM		825.	834.	1761.	75.	1071.	490.	1836.	1561.	3397.	22.70
AVERAGE		206.	208.	440.	19.	263.	122.	459.	390.	849.	5.67
3	1-1	156.	160.	325.	6.	148.	51.	331.	199.	530.	3.80
3	1-2	158.	160.	316.	9.	220.	90.	325.	310.	635.	3.60
3	1-3	161.	164.	365.	15.	209.	127.	375.	333.	708.	3.00
3	1-4	150.	150.	272.	12.	292.	161.	284.	453.	737.	2.60
SUM		625.	634.	1278.	42.	869.	429.	1315.	1295.	2610.	13.00
AVERAGE		156.	158.	319.	10.	217.	107.	329.	324.	652.	3.25
4	1-1	165.	165.	459.	31.	373.	144.	490.	517.	1007.	3.55
4	1-2	160.	164.	359.	13.	355.	145.	372.	500.	872.	3.15
4	1-3	187.	190.	436.	18.	297.	181.	454.	478.	932.	3.45
4	1-4	149.	149.	269.	14.	290.	111.	283.	401.	684.	3.20
SUM		661.	668.	1523.	76.	1315.	581.	1599.	1896.	3495.	13.35
AVERAGE		165.	167.	381.	19.	329.	145.	400.	474.	874.	3.34
CUMULATIVE SUM		2885.	2934.	6407.	302.	4341.	2051.	6704.	6389.	13093.	66.55
CUMULATIVE AVERAGE		180.	183.	400.	19.	271.	128.	419.	399.	818.	4.16

SALT LAKE COUNTY   SYSTEM NUMBER 1   ROUTE(1/1-4) 4TH QUARTER 5/22-25/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	DRIVERS TIME (MINUTES) DRIVING	WAITING	COLLECT	OTHER	TOTAL TIME	COLLECTORS TIME (MINUTES) RIDING	WALKING	WAITING	COMPACT	OTHER
1	1-1	36.09	0.00	0.00	100.86	136.95	36.09	0.11	0.00	1.03	4.20
1	1-2	38.22	0.00	0.00	101.80	140.02	38.22	0.00	0.00	0.12	2.53
1	1-3	29.20	0.00	0.00	72.68	101.88	29.20	0.00	0.00	0.00	1.71
1	1-4	30.51	0.00	0.00	71.58	102.09	30.51	0.00	0.00	1.08	1.49
SUM		134.01	0.00	0.00	346.92	480.93	134.01	0.11	0.00	2.23	9.92
AVERAGE		33.50	0.00	0.00	86.73	120.23	33.50	0.03	0.00	0.56	2.48
2	1-1	30.85	0.00	0.00	87.28	118.13	30.85	0.00	0.00	1.18	1.34
2	1-2	35.27	0.00	0.00	97.44	132.71	35.27	0.00	0.00	1.15	0.46
2	1-3	47.68	0.00	0.00	85.68	133.36	47.68	0.00	0.00	1.32	2.12
2	1-4	30.81	0.00	0.00	55.52	86.33	30.81	0.00	0.00	1.74	0.00
SUM		144.61	0.00	0.00	325.92	470.53	144.61	0.00	0.00	5.40	3.92
AVERAGE		36.15	0.00	0.00	81.48	117.63	36.15	0.00	0.00	1.35	0.98
3	1-1	23.71	0.00	0.00	57.34	81.04	23.71	0.00	0.00	0.89	0.00
3	1-2	26.80	0.00	0.00	69.57	96.37	26.80	0.00	0.00	2.17	0.32
3	1-3	25.80	0.00	0.00	64.32	90.12	25.80	0.00	0.00	0.23	0.18
3	1-4	19.06	0.00	0.00	54.06	73.12	19.06	0.00	0.00	0.36	0.00
SUM		95.36	0.00	0.00	245.29	340.65	95.36	0.00	0.00	3.65	0.50
AVERAGE		23.84	0.00	0.00	61.32	85.16	23.84	0.00	0.00	0.91	0.12
4	1-1	26.48	0.00	0.00	109.16	135.64	26.48	0.00	0.00	5.03	0.98
4	1-2	26.99	0.00	0.00	97.23	124.22	26.99	0.00	0.00	1.27	1.85
4	1-3	28.94	0.00	0.00	83.16	112.10	28.94	0.00	0.00	1.89	0.84
4	1-4	22.27	0.00	0.00	56.09	78.36	22.27	0.00	0.00	2.59	0.00
SUM		104.68	0.00	0.00	345.64	450.32	104.68	0.00	0.00	10.78	3.67
AVERAGE		26.17	0.00	0.00	86.41	112.58	26.17	0.00	0.00	2.70	0.92
CUMULATIVE SUM		478.66	0.00	0.00	1263.77	1742.43	478.66	0.11	0.00	22.06	18.02
CUMULATIVE AVERAGE		29.92	0.00	0.00	78.99	108.90	29.92	0.01	0.00	1.38	1.13

SALT LAKE COUNTY   SYSTEM NUMBER 1   ROUTE(1/1-4)   4TH QUARTER 5/22-25/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	TOTAL HANDLING TIME (MINUTES)	RATIO OF HANDLING TIME TO TOTAL TIME	TOTAL PRODUCTIVE TIME (MINUTES)	RATIO OF PRODUCTIVE TIME TO TOTAL TIME	TOTAL ITEMS HANDLED BY COLLECTORS
1	1-1	95.53		131.72		908.
1	1-2	99.15		137.37		881.
1	1-3	70.97		100.17		789.
1	1-4	69.01		99.52		1013.
	SUM	334.66		468.78		3591.
	AVERAGE	83.67		117.19		898.
2	1-1	84.75		115.60		833.
2	1-2	95.83		131.10		807.
2	1-3	82.24		129.91		950.
2	1-4	53.78		84.59		807.
	SUM	316.60		461.21		3397.
	AVERAGE	79.15		115.30		849.
3	1-1	56.45		80.16		530.
3	1-2	67.08		93.88		635.
3	1-3	63.91		89.70		708.
3	1-4	53.70		72.76		737.
	SUM	241.14		336.50		2610.
	AVERAGE	60.29		84.13		652.
4	1-1	103.15		129.63		1007.
4	1-2	94.10		121.09		872.
4	1-3	80.42		109.37		932.
4	1-4	53.50		75.77		684.
	SUM	331.18		435.86		3495.
	AVERAGE	82.79		108.97		874.
CUMULATIVE SUM		1223.58		1702.35		13093.
CUMULATIVE AVERAGE		76.47		106.40		818.

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          SALT LAKE COUNTY     SYSTEM NUMBER 1   ROUTE(1/1-4)  QUARTERS 1-4 5/25/73


                                                              ROUTE CUMULATIVES
                                                        ************************************

          *ALL TIMES ARE IN MINUTES*                         1-1       1-2       1-3       1-4
                                                        ************************************
                                                                 *         *         *

1) TIME EFFICIENCY OF CREW WHILE COLLECTING  =  96.89% * 98.00% * 98.10% * 97.86%
   ON ROUTE                                                      *         *         *
2) UTILIZATION OF DRIVERS TIME   A) DRIVING     = 24.83% * 25.80% * 30.09% * 30.20%
                                 B) WALKING     =  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING     =  0.00% *  0.00% *  0.00% *  0.00%
                                 D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER       = 75.17% * 74.20% * 69.91% * 69.80%
                                 F) COLLECTION=  0.00% *  0.00% *  0.00% *  0.00%
3) UTILIZATION OF COLLECTORS     A) RIDING      = 24.83% * 25.80% * 30.09% * 30.20%
   TIME                          B) WALKING     =  0.02% *  0.00% *  0.00% *  0.00%
                                 C) WAITING     =  0.00% *  0.00% *  0.00% *  0.00%
                                 D) COMPACTION=  1.72% *  0.96% *  0.79% *  1.70%
                                 E) OTHER       =  1.38% *  1.04% *  1.11% *  0.44%
                                 F) COLLECTION= 72.04% * 72.20% * 68.02% * 67.67%
4) AVERAGE NUMBER OF ITEMS       A) CANS        =   2.57  *   2.20  *   2.23  *   1.91
   BY TYPE / SERVICE             B) SMALL CANS=   0.13  *   0.06  *   0.11  *   0.10
                                 C) BAGS        =   1.54  *   1.45  *   1.41  *   1.59
                                 D) MISC.       =   0.58  *   0.73  *   0.77  *   0.75
5) RETURNABLE / NON-RETURNABLE   A) RETURN      =   2.70  *   2.28  *   2.33  *   2.01
   ITEMS / SERVICE               B) NO RET      =   2.12  *   2.21  *   2.17  *   2.34
6) AVERAGE NUMBER OF DWELLINGS / SERVICE        =   1.02  *   1.03  *   1.02  *   1.00
7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)      = 127.03  * 121.18  * 125.78  * 105.53
8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME       =   0.97  *   0.98  *   0.98  *   0.98
9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME    =   0.74  *   0.74  *   0.69  *   0.69
14) DUPLICATION OF HANDLING                     =   0.00% *   0.00% *   0.00% *   0.00%
15) A) TOTAL CREW TIME / DWELLING               =   0.68  *   0.67  *   0.57  *   0.45
    B) HANDLING TIME / DWELLING                 =   0.49  *   0.49  *   0.39  *   0.31
    C) PRODUCTIVE TIME / DWELLING               =   0.66  *   0.66  *   0.56  *   0.44
    D) CANS / DWELLING                          =   2.53  *   2.13  *   2.19  *   1.91
    E) SMALL CANS / DWELLING                    =   0.13  *   0.08  *   0.10  *   0.10
    F) BAGS / DWELLING                          =   1.52  *   1.44  *   1.38  *   1.58
    G) MISCELLANEOUS / DWELLING                 =   0.57  *   0.71  *   0.76  *   0.75
    H) RETURNABLES / DWELLING                   =   2.66  *   2.22  *   2.29  *   2.00
    I) NON-RETURNABLES / DWELLING               =   2.09  *   2.15  *   2.13  *   2.33
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SALT LAKE COUNTY    SYSTEM NUMBER 1   ROUTE(1/1-4)  4TH QUARTER 5/22-25/73


                                                                SYSTEM PERFORMANCE
                                                    ****************************************
                                                                  BY QUARTER                CUMU-
                     *ALL TIMES ARE IN MINUTES*          1ST       2ND       3RD       4TH     LATIVE
                                                    ****************************************
                                                              *         *         *         *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING       = 97.47% * 98.02% * 98.78% * 96.79% * 97.70%
    ON ROUTE                                                  *         *         *         *

 2) UTILIZATION OF DRIVERS TIME    A) DRIVING      = 27.86% * 30.73% * 27.99% * 23.25% * 27.47%
                                   B) WALKING      =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   C) WAITING      =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   D) COMPACTION=     0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   E) OTHER        = 72.14% * 69.27% * 72.01% * 76.75% * 72.53%
                                   F) COLLECTION=     0.00% *  0.00% *  0.00% *  0.00% *  0.00%

 3) UTILIZATION OF COLLECTORS      A) RIDING       = 27.86% * 30.73% * 27.99% * 23.25% * 27.47%
    TIME                           B) WALKING      =  0.02% *  0.00% *  0.00% *  0.00% *  0.01%
                                   C) WAITING      =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   D) COMPACTION=     0.46% *  1.15% *  1.07% *  2.39% *  1.27%
                                   E) OTHER        =  2.06% *  0.83% *  0.15% *  0.82% *  1.03%
                                   F) COLLECTION=    69.59% * 67.29% * 70.79% * 73.54% * 70.22%

 4) AVERAGE NUMBER OF ITEMS        A) CANS         =  2.38  *  2.13  *  2.04  *  2.30  *  2.22
    BY TYPE / SERVICE              B) SMALL CANS=     0.14  *  0.09  *  0.07  *  0.11  *  0.10
                                   C) BAGS         =  1.40  *  1.30  *  1.39  *  1.99  *  1.50
                                   D) MISC.        =  0.71  *  0.59  *  0.69  *  0.88  *  0.71

 5) RETURNABLE / NON-RETURNABLE    A) RETURN       =  2.52  *  2.23  *  2.10  *  2.42  *  2.32
    ITEMS / SERVICE                B) NO RET       =  2.11  *  1.89  *  2.07  *  2.87  *  2.21

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE          =  1.03  *  1.01  *  1.01  *  1.01  *  1.02

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)        = 115.79 * 143.71 * 108.26 * 105.52 * 119.76

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME         =  0.97  *  0.98  *  0.99  *  0.97  *  0.98

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME      =  0.71  *  0.69  *  0.72  *  0.76  *  0.72

14) DUPLICATION OF HANDLING                        =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%

15) A) TOTAL CREW TIME / DWELLING                  =  0.60  *  0.56  *  0.54  *  0.67  *  0.59
    B) HANDLING TIME / DWELLING                    =  0.42  *  0.38  *  0.38  *  0.50  *  0.42
    C) PRODUCTIVE TIME / DWELLING                  =  0.59  *  0.55  *  0.53  *  0.65  *  0.58
    D) CANS / DWELLING                             =  2.31  *  2.11  *  2.02  *  2.28  *  2.18
    E) SMALL CANS / DWELLING                       =  0.14  *  0.09  *  0.07  *  0.11  *  0.10
    F) BAGS / DWELLING                             =  1.36  *  1.28  *  1.37  *  1.97  *  1.48
    G) MISCELLANEOUS / DWELLING                    =  0.69  *  0.59  *  0.68  *  0.87  *  0.70
    H) RETURNABLES / DWELLING                      =  2.45  *  2.20  *  2.07  *  2.39  *  2.28
    I) NON-RETURNABLES / DWELLING                  =  2.05  *  1.87  *  2.04  *  2.84  *  2.18
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COVINA, CALIF.   SYSTEM NUMBER 2 ROUTE 2/1-4 4TH QUARTER   8/28/73-8/31/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE CANS	SMALL CANS	BAGS	MISCEL-LANEOUS	NUMBER OF RETURN-ABLE ITEMS	NUMBER OF NON RETURN-ABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
1	2-1	115.	119.	275.	80.	93.	98.	288.	258.	546.	2.30
1	2-2	145.	149.	388.	31.	169.	140.	405.	323.	728.	3.15
1	2-3	146.	148.	347.	17.	179.	88.	364.	270.	634.	3.65
1	2-4	132.	148.	323.	19.	146.	82.	342.	228.	570.	4.20
SUM		538.	564.	1333.	147.	587.	408.	1399.	1079.	2478.	13.30
AVERAGE		134.	141.	333.	37.	147.	102.	350.	270.	619.	3.32
2	2-1	183.	192.	446.	26.	196.	195.	472.	391.	863.	3.25
2	2-2	167.	167.	405.	13.	196.	180.	418.	376.	794.	3.20
2	2-3	181.	188.	465.	20.	258.	179.	485.	437.	922.	3.45
2	2-4	107.	113.	290.	12.	85.	116.	302.	201.	503.	3.00
SUM		638.	660.	1606.	71.	735.	670.	1677.	1405.	3082.	12.90
AVERAGE		159.	165.	401.	18.	184.	167.	419.	351.	770.	3.22
3	2-1	122.	123.	305.	31.	123.	125.	328.	255.	583.	7.29
3	2-2	127.	130.	308.	8.	193.	149.	316.	342.	658.	2.20
3	2-3	128.	132.	331.	18.	229.	104.	349.	333.	682.	1.95
3	2-4	66.	71.	172.	4.	67.	107.	176.	174.	350.	1.20
SUM		443.	456.	1116.	61.	612.	485.	1169.	1104.	2273.	12.64
AVERAGE		111.	114.	279.	15.	153.	121.	292.	276.	568.	3.16
4	2-1	108.	111.	314.	30.	138.	148.	344.	286.	630.	1.90
4	2-2	143.	145.	377.	19.	234.	235.	396.	469.	865.	3.45
4	2-3	112.	112.	264.	11.	235.	132.	275.	367.	642.	2.00
4	2-4	142.	145.	410.	24.	271.	236.	435.	507.	942.	2.35
SUM		505.	513.	1365.	84.	878.	751.	1450.	1629.	3079.	9.70
AVERAGE		126.	128.	341.	21.	219.	188.	362.	407.	770.	2.42
CUMULATIVE SUM		2124.	2193.	5420.	363.	2812.	2314.	5695.	5217.	10912.	48.54
CUMULATIVE AVERAGE		133.	137.	339.	23.	176.	145.	356.	326.	682.	3.03

COVINA, CALIF.   SYSTEM NUMBER 2 ROUTE 2/1-4 4TH QUARTER   8/28/73-8/31/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	DRIVERS TIME (MINUTES)				TOTAL TIME	COLLECTORS TIME (MINUTES)				
		DRIVING	WAITING	COLLECT	OTHER		RIDING	WALKING	WAITING	COMPACT	OTHER
1	2-1	24.38	0.00	0.00	89.60	113.99	24.38	0.00	0.00	4.32	3.37
1	2-2	26.45	0.00	0.00	94.29	120.74	26.45	0.00	0.00	1.98	1.73
1	2-3	25.21	0.00	0.00	75.44	100.65	25.21	0.00	0.00	0.73	3.88
1	2-4	37.40	0.00	0.00	95.28	132.68	37.40	0.00	0.00	1.28	2.82
SUM		113.44	0.00	0.00	354.61	468.05	113.44	0.00	0.00	8.32	11.80
AVERAGE		28.36	0.00	0.00	88.65	117.01	28.36	0.00	0.00	2.08	2.95
2	2-1	33.31	0.00	0.00	141.56	174.87	33.31	0.18	0.24	5.44	0.65
2	2-2	26.72	0.00	0.00	118.25	144.96	26.72	0.00	0.00	1.63	1.71
2	2-3	31.45	0.00	0.00	110.81	142.25	31.45	0.25	0.00	3.09	4.75
2	2-4	23.88	0.00	0.00	76.54	100.42	23.88	0.00	0.38	5.01	1.78
SUM		115.36	0.00	0.00	447.15	562.51	115.36	0.43	0.62	15.19	8.90
AVERAGE		28.84	0.00	0.00	111.79	140.63	28.84	0.11	0.16	3.80	2.22
3	2-1	21.32	0.00	0.00	97.67	118.99	21.32	0.00	0.00	2.00	1.37
3	2-2	21.82	0.00	0.00	84.66	106.49	21.82	0.00	0.00	1.04	0.13
3	2-3	15.70	0.00	0.00	71.74	87.44	15.70	0.00	0.00	3.99	0.51
3	2-4	8.92	0.00	0.00	48.03	56.95	8.92	0.00	0.00	1.26	1.28
SUM		67.77	0.00	0.00	302.10	369.87	67.77	0.00	0.00	8.29	3.29
AVERAGE,		16.94	0.00	0.00	75.53	92.47	16.94	0.00	0.00	2.07	0.82
4	2-1	18.58	0.00	0.00	104.92	123.50	18.58	0.00	0.00	1.84	0.40
4	2-2	22.49	0.00	0.00	114.22	136.71	22.49	0.00	0.00	3.14	0.61
4	2-3	16.09	0.00	0.00	73.63	89.72	16.09	0.00	0.00	4.00	0.20
4	2-4	24.90	6.33	0.00	125.06	149.96	24.90	0.00	0.00	4.71	1.99
SUM		82.06	6.33	0.00	417.82	499.88	82.06	0.00	0.00	13.70	3.20
AVERAGE		20.52	1.58	0.00	104.45	124.97	20.52	0.00	0.00	3.43	0.80
CUMULATIVE SUM		378.63	6.33	0.00	1521.69	1900.32	378.63	0.43	0.62	45.49	27.18
CUMULATIVE AVERAGE		23.66	0.40	0.00	95.11	118.77	23.66	0.03	0.04	2.84	1.70

```
COVINA, CALIF.   SYSTEM NUMBER 2  ROUTE 2/1-4  4TH QUARTER   8/28/73-8/31/73

                          TIME & MOTION DATA REDUCTION

*****************************************************************************************
*         *          *                  *                  *             *              *              *
*         *          *                  *                  *    TOTAL    * RATIO OF     *              *
*         *          * TOTAL HANDLING   * RATIO OF         * PRODUCTIVE' * PRODUCTIVE   * TOTAL ITEMS  *
*         *          *      TIME        * HANDLING TIME    *    TIME     * TIME TO      * HANDLED BY   *
* QUARTER *   ROUTE  *   (MINUTES)      * TO TOTAL TIME    *  (MINUTES)  * TOTAL TIME   * COLLECTORS   *
*****************************************************************************************
    1        2-1          81.92                                106.30
    1        2-2          90.57                                117.02                        546.
    1        2-3          70.82                                 96.03                        728.
    1        2-4          91.18                                128.58                        634.
             SUM         334.50                                447.94                        570.
           AVERAGE        83.62                                111.98                       2478.
                                                                                             619.


    2        2-1         135.04                                168.53
    2        2-2         114.90                                141.62                        863.
    2        2-3         102.71                                134.41                        794.
    2        2-4          69.36                                 93.24                        927.
             SUM         422.01                                537.80                        506.
           AVERAGE       105.50                                134.45                       3090.
                                                                                             772.


    3        2-1          94.30                                115.63
    3        2-2          83.50                                105.32                        584.
    3        2-3          67.24                                 82.94                        658.
    3        2-4          45.49                                 54.41                        682.
             SUM         290.53                                358.29                        350.
           AVERAGE        72.63                                 89.57                       2274.
                                                                                             568.


    4        2-1         102.67                                121.25
    4        2-2         110.47                                132.96                        630.
    4        2-3          69.42                                 85.51                        865.
    4        2-4         118.36                                143.26                        652.
             SUM         400.92                                482.98                        942.
           AVERAGE       100.23                                120.75                       3089.
                                                                                             772.

CUMULATIVE SUM          1447.96
CUMULATIVE AVERAGE        90.50                               1827.02                      10931.
                                                               114.19                        683.
```

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              COVINA, CALIF.  SYSTEM NUMBER 2  ROUTE 2/1-4  QUARTERS 1-4  11/21/72-8/31/73

                                                                   ROUTE CUMULATIVES
                                                           ***********************************
                   *ALL TIMES ARE IN MINUTES*                 2-1       2-2       2-3       2-4
                                                           ***********************************
                                                                    *         *         *

 1) TIME EFFICIENCY OF CREW WHILE COLLECTING          = 96.30% * 97.65% * 94.96% * 95.34%
    ON ROUTE                                                    *         *         *
 2) UTILIZATION OF DRIVERS TIME     A) DRIVING    = 18.37% * 19.16% * 21.06% * 21.31%
                                    B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00%
                                    C) WAITING    =  0.00% *  0.00% *  0.00% *  1.42%
                                    D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00%
                                    E) OTHER      = 81.63% * 80.84% * 78.94% * 77.28%
                                    F) COLLECTION=  0.00% *  0.00% *  0.00% *  0.00%
 3) UTILIZATION OF COLLECTORS       A) RIDING     = 18.37% * 19.16% * 21.06% * 21.61%
    TIME                            B) WALKING    =  0.03% *  0.00% *  0.06% *  0.00%
                                    C) WAITING    =  0.05% *  0.00% *  0.00% *  0.09%
                                    D) COMPACTION=  2.56% *  1.53% *  2.81% *  2.79%
                                    E) OTHER      =  1.09% *  0.82% *  2.23% *  1.79%
                                    F) COLLECTION= 77.90% * 78.49% * 73.84% * 73.72%
 4) AVERAGE NUMBER OF ITEMS         A) CANS       =  2.54   *  2.54   *  2.48   *  2.67
    BY TYPE / SERVICE               B) SMALL CANS=  0.32   *  0.12   *  0.12   *  0.13
                                    C) BAGS       =  1.04   *  1.36   *  1.59   *  1.27
                                    D) MISC.      =  1.07   *  1.21   *  0.89   *  1.21
 5) RETURNABLE / NON-RETURNABLE     A) RETURN     =  2.71   *  2.64   *  2.60   *  2.81
    ITEMS / SERVICE                 B) NO RET     =  2.25   *  2.59   *  2.48   *  2.48
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE         =  1.03   *  1.02   *  1.02   *  1.07
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)       =142.80   *107.21   *100.59   *118.99
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME        =  0.96   *  0.98   *  0.95   *  0.95
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME     =  0.81   *  0.80   *  0.78   *  0.77
14) DUPLICATION OF HANDLING                        =  0.04% *  0.00% *  0.52% *  0.13%
15) A) TOTAL CREW TIME / DWELLING                  =  0.97   *  0.86   *  0.72   *  0.92
    B) HANDLING TIME / DWELLING                    =  0.76   *  0.68   *  0.53   *  0.68
    C) PRODUCTIVE TIME / DWELLING                  =  0.94   *  0.84   *  0.69   *  0.88
    D) CANS / DWELLING                             =  2.46   *  2.50   *  2.43   *  2.51
    E) SMALL CANS / DWELLING                       =  0.31   *  0.12   *  0.11   *  0.12
    F) BAGS / DWELLING                             =  1.01   *  1.34   *  1.55   *  1.19
    G) MISCELLANEOUS / DWELLING                    =  1.04   *  1.19   *  0.87   *  1.13
    H) RETURNABLES / DWELLING                      =  2.63   *  2.60   *  2.54   *  2.63
    I) NON-RETURNABLES / DWELLING                  =  2.18   *  2.55   *  2.43   *  2.33
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        COVINA, CALIF.   SYSTEM NUMBER 2  ROUTE 2/1-4  4TH QUARTER   8/28/73-8/31/73

                                                            SYSTEM PERFORMANCE
                                                   *********************************************
                                                              BY QUARTER                  CUMU-
         *ALL TIMES ARE IN MINUTES*                      1ST     2ND      3RD      4TH     LATIVE
                                                   *********************************************
                                                            *        *        *        *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING       = 95.70% * 95.61% * 96.87% * 96.62% * 96.14%
    ON ROUTE                                                *        *        *        *

 2) UTILIZATION OF DRIVERS TIME   A) DRIVING       = 24.24% * 20.51% * 18.32% * 16.21% * 19.86%
                                  B) WALKING       =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                  C) WAITING       =  0.00% *  0.00% *  0.00% *  1.25% *  0.33%
                                  D) COMPACTION=      0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                  E) OTHER         = 75.76% * 79.49% * 81.68% * 82.54% * 79.81%
                                  F) COLLECTION=      0.00% *  0.00% *  0.00% *  0.00% *  0.00%

 3) UTILIZATION OF COLLECTORS     A) RIDING        = 24.24% * 20.51% * 18.32% * 16.42% * 19.92%
    TIME                          B) WALKING       =  0.00% *  0.08% *  0.00% *  0.00% *  0.02%
                                  C) WAITING       =  0.00% *  0.11% *  0.00% *  0.00% *  0.03%
                                  D) COMPACTION=      1.78% *  2.70% *  2.24% *  2.74% *  2.39%
                                  E) OTHER         =  2.52% *  1.58% *  0.89% *  0.64% *  1.43%
                                  F) COLLECTION=     71.47% * 75.02% * 78.55% * 80.20% * 76.20%

 4) AVERAGE NUMBER OF ITEMS       A) CANS          =  2.48  *  2.52  *  2.52  *  2.70  *  2.55
    BY TYPE / SERVICE             B) SMALL CANS=      0.27  *  0.11  *  0.14  *  0.17  *  0.17
                                  C) BAGS          =  1.09  *  1.15  *  1.38  *  1.74  *  1.32
                                  D) MISC.         =  0.76  *  1.05  *  1.09  *  1.49  *  1.09

 5) RETURNABLE / NON-RETURNABLE   A) RETURN        =  2.60  *  2.63  *  2.64  *  2.87  *  2.68
    ITEMS / SERVICE               B) NO RET        =  2.01  *  2.20  *  2.49  *  3.23  *  2.46

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE          =  1.05  *  1.03  *  1.03  *  1.02  *  1.03

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)        = 124.51 * 103.20 * 146.36 *  99.84 * 116.87

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME         =  0.96  *  0.96  *  0.97  *  0.97  *  0.96

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME      =  0.75  *  0.78  *  0.81  *  0.83  *  0.79

14) DUPLICATION OF HANDLING
                                                   =  0.00% *  0.26% *  0.04% *  0.32% *  0.17%

15) A) TOTAL CREW TIME / DWELLING
    B) HANDLING TIME / DWELLING                    =  0.83  *  0.85  *  0.81  *  0.97  *  0.87
    C) PRODUCTIVE TIME / DWELLING                  =  0.59  *  0.64  *  0.64  *  0.78  *  0.66
    D) CANS / DWELLING                             =  0.79  *  0.81  *  0.79  *  0.94  *  0.83
    E) SMALL CANS / DWELLING                       =  2.36  *  2.43  *  2.45  *  2.66  *  2.47
    F) BAGS / DWELLING                             =  0.26  *  0.11  *  0.13  *  0.16  *  0.17
    G) MISCELLANEOUS / DWELLING                    =  1.04  *  1.11  *  1.34  *  1.71  *  1.28
    H) RETURNABLES / DWELLING                      =  0.72  *  1.02  *  1.06  *  1.46  *  1.06
    I) NON-RETURNABLES / DWELLING                  =  2.48  *  2.54  *  2.56  *  2.83  *  2.60
                                                   =  1.91  *  2.13  *  2.42  *  3.18  *  2.38
```

PHOENIX, ARIZ. SYSTEM NUMBER 3 ROUTE(3/1-4) 4TH QUARTER 9/10/73-9/21/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE: CANS	SMALL CANS	BAGS	MISCELLANEOUS	NUMBER OF RETURNABLE ITEMS	NUMBER OF NON RETURNABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
1	3-1	96.	139.	154.	0.	62.	34.	154.	96.	250.	2.94
1	3-2	172.	179.	284.	7.	140.	101.	291.	241.	532.	4.47
1	3-3	131.	132.	170.	10.	199.	108.	190.	309.	499.	3.94
1	3-4	120.	120.	202.	14.	148.	98.	216.	246.	462.	2.25
	SUM	517.	558.	810.	31.	549.	341.	841.	892.	1733.	13.60
	AVERAGE	129.	139.	202.	8.	137.	85.	210.	223.	433.	3.40
2	3-1	130.	141.	131.	3.	108.	67.	134.	172.	306.	2.37
2	3-2	150.	152.	192.	3.	76.	41.	195.	117.	312.	3.13
2	3-3	132.	132.	197.	10.	121.	49.	207.	170.	377.	3.49
2	3-4	155.	155.	270.	13.	93.	56.	283.	149.	432.	4.37
	SUM	567.	580.	790.	29.	398.	213.	819.	608.	1427.	13.36
	AVERAGE	142.	145.	197.	7.	99.	53.	205.	152.	357.	3.34
3	3-1	52.	62.	114.	2.	50.	21.	116.	71.	187.	0.79
3	3-2	145.	144.	242.	5.	99.	43.	247.	142.	389.	2.98
3	3-3	135.	134.	201.	4.	119.	67.	207.	186.	393.	3.29
3	3-4	75.	74.	164.	7.	58.	70.	171.	128.	299.	1.97
	SUM	407.	414.	721.	18.	326.	201.	741.	527.	1268.	9.03
	AVERAGE	102.	103.	180.	4.	81.	50.	185.	132.	317.	2.26
4	3-1	78.	83.	112.	1.	51.	34.	113.	85.	198.	0.62
4	3-2	193.	193.	276.	9.	142.	90.	283.	232.	515.	1.86
4	3-3	147.	147.	185.	11.	147.	52.	196.	199.	395.	2.41
4	3-4	155.	155.	299.	9.	163.	103.	308.	266.	574.	1.04
	SUM	573.	578.	872.	30.	503.	279.	900.	782.	1682.	5.93
	AVERAGE	143.	144.	218.	8.	126.	70.	225.	195.	420.	1.48
CUMULATIVE SUM		2064.	2130.	3193.	108.	1776.	1034.	3301.	2809.	6110.	41.90
CUMULATIVE AVERAGE		129.	133.	200.	7.	111.	65.	206.	176.	382.	2.62

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PHOENIX, ARIZ.   SYSTEM NUMBER 3 ROUTE(3/1-4)  4TH QUARTER  9/18/72-6/21/73

                              TIME & MOTION DATA REDUCTION

*****************************************************************************************************************
*          *           *              DRIVERS                   *               COLLECTORS TIME                *
*          *           *                TIME                    *                  (MINUTES)                   *
*          *           *              (MINUTES)                 ************************************************
*          *           ***************************************** TOTAL *        *         *         *         *
* QUARTER  *  ROUTE    * DRIVING * WAITING * COLLECT * OTHER   * TIME  * RIDING * WALKING * WAITING * COMPACT * OTHER *
*****************************************************************************************************************
   1          3-1        21.90     0.00      0.00     35.84     57.73    21.90     0.00      0.00      0.39     0.47
   1          3-2        34.04     0.00      0.00     67.72    101.76    34.04     0.14      0.00      4.37     0.53
   1          3-3        30.50     0.00      0.00     66.16     96.66    30.50     0.00      0.00      1.68     0.85
   1          3-4        21.25     0.00      0.00     51.99     73.24    21.25     0.00      0.00      1.80     0.51
          SUM           107.68     0.00      0.00    221.71    329.39   107.68     0.14      0.00      8.24     2.37
          AVERAGE        26.92     0.00      0.00     55.43     82.35    26.92     0.03      0.00      2.06     0.59

   2          3-1        28.40     0.00      0.00     62.12     90.52    28.40     0.00      0.00      0.00     0.83
   2          3-2        24.51     0.00      0.00     49.11     73.62    24.51     0.00      0.00      0.00     0.00
   2          3-3        30.01     0.00      0.00     57.75     87.76    30.01     0.00      0.00      0.25     0.75
   2          3-4        28.27     0.00      0.00     54.03     82.30    28.27     0.00      0.00      0.50     0.17
          SUM           111.19     0.00      0.00    223.01    334.20   111.19     0.00      0.00      0.75     1.75
          AVERAGE        27.80     0.00      0.00     55.75     83.55    27.80     0.00      0.00      0.19     0.44

   3          3-1        16.15     0.00      0.00     21.78     37.94    16.15     0.27      0.00      1.11     0.83
   3          3-2        22.32     0.00      0.00     51.13     73.43    22.32     1.52      0.09      1.23     0.97
   3          3-3        30.67     0.00      0.00     60.87     91.54    30.67     0.12      0.12      3.18     1.01
   3          3-4        10.69     0.00      0.00     53.93     64.62    10.69     1.13      0.00      2.62     1.47
          SUM            79.84     0.00      0.00    187.69    267.53    79.84     3.04      0.21      8.11     4.27
          AVERAGE        19.96     0.00      0.00     46.92     66.88    19.96     0.76      0.05      2.03     1.07

   4          3-1        14.89     0.00      0.00     31.50     46.39    14.89     0.07      0.00      0.00     0.58
   4          3-2        30.39     0.00      0.00     76.57    106.96    30.39     0.19      0.00      0.00     2.41
   4          3-3        32.96     0.00      0.00     58.53     91.48    32.96     0.00      0.00      0.17     0.41
   4          3-4        29.15     0.00      0.00     67.58     96.74    29.15     0.00      0.00      0.40     0.96
          SUM           107.39     0.00      0.00    234.18    341.57   107.39     0.26      0.00      0.57     4.36
          AVERAGE        26.85     0.00      0.00     58.54     85.39    26.85     0.07      0.00      0.14     1.09

CUMULATIVE SUM          406.10     0.00      0.00    866.59   1272.69   406.10     3.44      0.21     17.67    13.09
CUMULATIVE AVERAGE       25.38     0.00      0.00     54.16     79.54    25.38     0.22      0.01      1.10     0.82
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PHOENIX, ARIZ.   SYSTEM NUMBER 3 ROUTE(3/1-4)  4TH QUARTER  9/18/78-9/21/78

                        TIME & MOTION DATA REDUCTION

*****************************************************************************************
*          *            * TOTAL HANDLING * RATIO OF       *    TOTAL     * RATIO OF     *                *
*          *            *      TIME      * HANDLING TIME  *  PRODUCTIVE  * PRODUCTIVE   * TOTAL ITEMS    *
* QUARTER  *   ROUTE    *   (MINUTES)    * TO TOTAL TIME  *     TIME     * TIME TO      * HANDLED BY     *
*          *            *                *                *  (MINUTES)   * TOTAL TIME   * COLLECTORS     *
*****************************************************************************************
    1          3-1           34.97
    1          3-2           62.68                            56.97
    1          3-3           63.62                            96.96                          250.
    1          3-4           49.68                            94.12                          532.
               SUM          210.96                            70.94                          489.
             AVERAGE         52.74                           318.78                          462.
                                                              79.69                         1733.
                                                                                             433.


    2          3-1           61.28
    2          3-2           49.11                            89.66                          306.
    2          3-3           56.75                            73.62                          312.
    2          3-4           53.37                            86.76                          377.
               SUM          220.51                            81.66                          432.
             AVERAGE         55.13                           331.70                         1427.
                                                              82.92                          357.


    3          3-1           20.27
    3          3-2           47.33                            36.69                          187.
    3          3-3           55.63                            71.17                          389.
    3          3-4           48.43                            86.43                          393.
               SUM          171.66                            60.25                          299.
             AVERAGE         42.91                           254.54                         1268.
                                                              63.63                          317.


    4          3-1           30.88
    4          3-2           73.97                            45.85                          198.
    4          3-3           57.95                           104.55                          515.
    4          3-4           66.25                            90.90                          395.
               SUM          229.05                            95.40                          574.
             AVERAGE         57.26                           336.70                         1682.
                                                              84.18                          420.

CUMULATIVE SUM              832.18
CUMULATIVE AVERAGE           52.01                          1241.72                         6110.
                                                              77.61                          382.
```

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PHOENIX, ARIZ.  SYSTEM NUMBER 3 ROUTE(3/1-4)  QUARTERS 1-4  12/19/72-9/21/73

                                                         ROUTE CUMULATIVES
                                                   *************************************
        *ALL TIMES ARE IN MINUTES*                    3-1       3-2       3-3       3-4
                                                   *************************************
                                                            *         *         *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING      * 98.50% * 97.31% * 97.49% * 97.26%
    ON ROUTE                                                *         *         *
 2) UTILIZATION OF DRIVERS TIME   A) DRIVING     = 34.97% * 31.27% * 33.78% * 28.20%
                                  B) WALKING     =  0.00% *  0.00% *  0.00% *  0.00%
                                  C) WAITING     =  0.00% *  0.00% *  0.00% *  0.00%
                                  D) COMPACTION  =  0.00% *  0.00% *  0.00% *  0.00%
                                  E) OTHER       = 65.03% * 68.73% * 66.22% * 71.80%
                                  F) COLLECTION  =  0.00% *  0.00% *  0.00% *  0.00%
 3) UTILIZATION OF COLLECTORS     A) RIDING      = 34.97% * 31.27% * 33.78% * 28.20%
    TIME                          B) WALKING     =  0.14% *  0.52% *  0.03% *  0.36%
                                  C) WAITING     =  0.00% *  0.02% *  0.03% *  0.00%
                                  D) COMPACTION  =  0.65% *  1.57% *  1.44% *  1.68%
                                  E) OTHER       =  0.85% *  1.10% *  1.04% *  1.06%
                                  F) COLLECTION  = 63.38% * 65.52% * 63.67% * 69.71%
 4) AVERAGE NUMBER OF ITEMS       A) CANS        =  1.44  *  1.51  *  1.38  *  1.85
    BY TYPE / SERVICE             B) SMALL CANS  =  0.02  *  0.04  *  0.06  *  0.09
                                  C) BAGS        =  0.77  *  0.69  *  1.09  *  0.91
                                  D) MISC.       =  0.44  *  0.42  *  0.51  *  0.55
 5) RETURNABLE / NON-RETURNABLE   A) RETURN      =  1.46  *  1.54  *  1.45  *  1.94
    ITEMS / SERVICE               B) NO RET      =  1.20  *  1.11  *  1.59  *  1.56
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE        =  1.18  *  1.00  *  1.00  *  1.00
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)      = 84.43  * 99.38  *126.82  *101.10
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME       =  0.98  *  0.97  *  0.97  *  0.97
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME    =  0.64  *  0.67  *  0.65  *  0.71
10) DUPLICATION OF HANDLING                      =  0.00% *  0.00% *  0.00% *  0.00%
11) A) TOTAL CREW TIME / DWELLING                =  0.56  *  0.54  *  0.67  *  0.63
    B) HANDLING TIME / DWELLING                  =  0.35  *  0.35  *  0.43  *  0.43
    C) PRODUCTIVE TIME / DWELLING                =  0.55  *  0.52  *  0.66  *  0.61
    D) CANS / DWELLING                           =  1.22  *  1.50  *  1.38  *  1.86
    E) SMALL CANS / DWELLING                     =  0.01  *  0.04  *  0.06  *  0.09
    F) BAGS / DWELLING                           =  0.65  *  0.69  *  1.08  *  0.92
    G) MISCELLANEOUS / DWELLING                  =  0.37  *  0.42  *  0.51  *  0.65
    H) RETURNABLES / DWELLING                    =  1.23  *  1.53  *  1.45  *  1.94
    I) NON-RETURNABLES / DWELLING                =  1.01  *  1.11  *  1.59  *  1.57
```

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PHOENIX, ARIZ.   SYSTEM NUMBER 3 ROUTE(3/1-4)  4TH QUARTER  9/18/73-9/21/73

                                                             SYSTEM PERFORMANCE
                                                   ***************************************************
                                                                 BY QUARTER
          *ALL TIMES ARE IN MINUTES*                   1ST      2ND       3RD       4TH      CUMU-
                                                                                             LATIVE
                                                   ***************************************************
                                                             *         *         *         *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING  * 96.70% * 97.25% * 95.14% * 98.57% * 97.57%
    ON ROUTE                                             *         *         *         *

 2) UTILIZATION OF DRIVERS TIME  A) DRIVING    = 32.69% * 33.27% * 29.84% * 31.44% * 31.91%
                                 B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 D) COMPACTION=   0.00% *  0.00% *  0.00% *  0.00% *  0.03%
                                 E) OTHER      = 67.31% * 66.73% * 70.16% * 68.56% * 68.09%
                                 F) COLLECTION=   0.00% *  0.00% *  0.00% *  0.00% *  0.00%

 3) UTILIZATION OF COLLECTORS    A) RIDING     = 32.69% * 33.27% * 29.84% * 31.44% * 31.91%
    TIME                         B) WALKING    =  0.04% *  0.00% *  1.14% *  0.36% *  0.27%
                                 C) WAITING    =  0.00% *  0.00% *  0.38% *  0.00% *  0.02%
                                 D) COMPACTION=   2.50% *  0.22% *  3.03% *  0.17% *  1.39%
                                 E) OTHER      =  0.72% *  0.52% *  1.74% *  1.26% *  1.03%
                                 F) COLLECTION= 64.04% * 65.98% * 64.10% * 67.06% * 65.39%

 4) AVERAGE NUMBER OF ITEMS      A) CANS       =  1.57  *  1.39  *  1.77  *  1.52  *  1.58
    BY TYPE / SERVICE            B) SMALL CANS=   0.06  *  0.05  *  0.04  *  0.35  *  0.05
                                 C) BAGS       =  1.06  *  0.70  *  0.80  *  0.58  *  0.86
                                 D) MISC.      =  0.66  *  0.38  *  0.49  *  0.49  *  0.53

 5) RETURNABLE / NON-RETURNABLE  A) RETURN     =  1.63  *  1.44  *  1.82  *  1.57  *  1.60
    ITEMS / SERVICE              B) NO RET     =  1.73  *  1.07  *  1.29  *  1.36  *  1.36

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE      =  1.00  *  1.02  *  1.02  *  1.01  *  1.01

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)    = 128.69 * 121.44 * 115.17 *  94.17 * 103.86

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME     =  0.97  *  0.99  *  0.95  *  0.99  *  0.98

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME  =  0.66  *  0.66  *  0.67  *  0.68  *  0.67

10) DUPLICATION OF HANDLING                    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%

11) A) TOTAL CREW TIME / DWELLING              =  0.59  *  0.58  *  0.65  *  0.59  *  0.60
    B) HANDLING TIME / DWELLING                =  0.38  *  0.38  *  0.41  *  0.40  *  0.39
    C) PRODUCTIVE TIME / DWELLING              =  0.57  *  0.57  *  0.61  *  0.58  *  0.58
    D) CANS / DWELLING                         =  1.45  *  1.36  *  1.74  *  1.51  *  1.53
    E) SMALL CANS / DWELLING                   =  0.06  *  0.05  *  0.04  *  0.05  *  0.05
    F) BAGS / DWELLING                         =  0.98  *  0.69  *  0.79  *  0.57  *  0.83
    G) MISCELLANEOUS / DWELLING                =  0.61  *  0.37  *  0.49  *  0.48  *  0.49
    H) RETURNABLES / DWELLING                  =  1.51  *  1.41  *  1.79  *  1.56  *  1.55
    I) NON-RETURNABLES / DWELLING              =  1.60  *  1.05  *  1.27  *  1.35  *  1.32
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ROCKFORD, ILLINOIS  SYSTEM NUMBER 4  ROUTE(4/1-4)  4TH QUARTER 9/11/73-9/14/73

                         TIME & MOTION DATA REDUCTION

****************************************************************************************************
*         *         *          *          *                                   * NUMBER  * NUMBER  *        *          *
*         *         *          *          *          NUMBER                   *         * OF NON  *        *          *
*         *         *          *          *        OF ITEMS                   * OF      * RETURN- *        *  ROUTE   *
*         *         * NUMBER   * NUMBER   *        BY TYPE                    * RETURN- * ABLE    *        * DISTANCE *
*         *         * OF       * OF       ************************************* ABLE    *         * TOTAL  ************
* QUARTER * ROUTE   * SERVICES * DWELLINGS* CANS * SMALL * BAGS * MISCEL-     * ITEMS   * ITEMS   * ITEMS  * (MILES)  *
*         *         *          *          *      * CANS  *      * LANEOUS     *         *         *        *          *
****************************************************************************************************
    1        4-1       220.       234.     289.    20.    599.     157.        309.      756.    1065.      9.30
    1        4-2       215.       255.     256.    25.    607.      93.        281.      700.     981.      7.60
    1        4-3       192.       218.     204.     9.    458.      95.        213.      553.     766.      5.80
    1        4-4       243.       282.     273.    48.    665.     162.        321.      827.    1148.      8.00
        SUM            870.       989.    1022.   102.   2329.     507.       1124.     2836.    3960.     30.70
      AVERAGE          217.       247.     255.    25.    582.     127.        281.      709.     990.      7.67

    2        4-1       357.       395.     505.    27.    922.     203.        532.     1125.    1657.     12.00
    2        4-2       289.       328.     375.    57.    883.     220.        432.     1103.    1535.      6.80
    2        4-3       302.       304.     272.    35.    628.     234.        307.      862.    1169.      6.80
    2        4-4       276.       285.     254.    54.    754.     161.        308.      915.    1223.      4.94
        SUM           1224.      1312.    1406.   173.   3187.     818.       1579.     4005.    5584.     30.54
      AVERAGE          306.       328.     351.    43.    797.     204.        395.     1001.    1396.      7.63

    3        4-1       209.       210.     315.    31.    532.     191.        346.      723.    1069.      4.90
    3        4-2       207.       218.     259.    56.    645.     107.        315.      752.    1067.      4.70
    3        4-3       228.       230.     262.    42.    576.     246.        303.      822.    1125.      3.40
    3        4-4       205.       207.     197.    68.    472.     179.        265.      651.     916.      4.30
        SUM            849.       865.    1033.   197.   2225.     723.       1229.     2948.    4177.     17.30
      AVERAGE          212.       216.     258.    49.    556.     181.        307.      737.    1044.      4.32

    4        4-1       178.       195.     215.    23.    473.     110.        238.      583.     821.      5.70
    4        4-2       180.       192.     234.    44.    529.     169.        278.      698.     976.      3.90
    4        4-3       201.       201.     204.    22.    475.     176.        226.      651.     877.      3.80
    4        4-4        81.        81.      74.    28.    164.      61.        102.      225.     327.      1.40
        SUM            640.       669.     727.   117.   1641.     516.        844.     2157.    3001.     14.80
      AVERAGE          160.       167.     182.    29.    410.     129.        211.      539.     750.      3.70

CUMULATIVE SUM        3503.      3835.    4188.   589.   9382.    2564.       4776.    11946.   16722.     93.34

CUMULATIVE AVERAGE     224.       240.     262.    37.    586.     160.        298.      747.    1045.      5.83
```

ROCKFORD, ILLINOIS SYSTEM NUMBER 4 ROUTE(4/1-4) 4TH QUARTER 9/11/73-9/14/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	DRIVERS TIME (MINUTES)				COLLECTORS TIME (MINUTES)					
		DRIVING	WAITING	COLLECT	OTHER	TOTAL TIME	RIDING	WALKING	WAITING	COMPACT	OTHER
1	4-1	51.09	98.92	8.72	3.85	169.81	33.75	10.14	0.14	10.17	0.00
1	4-2	49.04	81.88	17.94	0.57	148.82	32.40	10.74	0.00	8.57	2.07
1	4-3	34.91	75.23	6.21	0.00	113.63	28.20	3.46	0.19	10.41	1.08
1	4-4	39.47	54.12	22.17	0.51	116.23	23.05	12.93	0.00	8.43	0.00
SUM		174.52	310.16	55.04	4.93	548.50	117.40	37.27	0.33	37.58	3.16
AVERAGE		43.63	77.54	13.76	1.23	137.13	29.35	9.32	0.08	9.39	0.79
2	4-1	59.19	128.09	8.07	0.87	195.33	42.17	10.16	2.96	19.85	2.56
2	4-2	40.52	72.13	22.53	0.00	135.05	19.53	11.86	2.05	10.96	0.00
2	4-3	33.96	73.86	3.33	0.00	111.11	17.92	11.34	1.20	15.04	0.36
2	4-4	26.57	32.44	37.50	0.00	95.48	8.60	13.14	2.13	10.88	1.67
SUM		160.24	306.52	71.43	0.87	536.98	88.22	46.49	8.33	56.74	4.60
AVERAGE		40.06	76.63	17.86	0.22	134.24	22.06	11.62	2.08	14.18	1.15
3	4-1	32.90	89.75	11.12	0.46	133.63	24.13	5.95	1.69	16.06	2.52
3	4-2	27.45	49.93	20.43	0.00	97.94	14.19	9.34	1.48	6.58	0.15
3	4-3	22.45	61.60	22.68	0.00	106.76	11.03	7.62	0.89	13.29	0.21
3	4-4	20.91	31.07	25.74	1.10	78.76	8.28	10.92	1.37	8.39	1.35
SUM		103.70	232.36	79.98	1.57	417.10	57.63	33.83	5.43	44.33	4.24
AVERAGE		25.93	58.09	19.99	0.39	104.27	14.41	8.46	1.36	11.08	1.06
4	4-1	29.04	73.16	5.62	0.08	107.82	24.20	2.52	0.75	6.96	0.31
4	4-2	22.64	59.82	18.77	0.67	101.94	15.33	4.64	0.33	5.72	0.40
4	4-3	21.16	46.35	17.26	0.00	83.57	14.25	5.56	0.09	3.23	0.31
4	4-4	7.29	24.03	0.81	0.00	31.45	5.10	2.53	0.25	0.57	0.63
SUM		80.14	203.35	42.46	0.75	324.78	58.88	15.25	1.42	16.48	1.65
AVERAGE		20.03	50.84	10.62	0.19	81.20	14.72	3.81	0.36	4.12	0.41
CUMULATIVE SUM		518.60	1052.39	248.91	8.11	1827.36	322.14	132.05	15.52	155.13	13.65
CUMULATIVE AVERAGE		32.41	85.77	15.56	0.51	114.21	20.13	8.30	0.97	9.70	0.85

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            ROCKFORD, ILLINOIS  SYSTEM NUMBER 4   ROUTE(4/1-4)  4TH QUARTER 9/11/73-9/14/73


                                       TIME & MOTION DATA REDUCTION

**************************************************************************************************
*         *            *                 *                *              *               *                *
*         *            * TOTAL HANDLING  * RATIO OF       *    TOTAL     * RATIO OF      *                *
*         *            *      TIME       * HANDLING TIME  *  PRODUCTIVE  * PRODUCTIVE    * TOTAL ITEMS    *
*         *            *                 *                *     TIME     * TIME TO       * HANDLED BY     *
* QUARTER *   ROUTE    *    (MINUTES)    * TO TOTAL TIME  *   (MINUTES)  * TOTAL TIME    * COLLECTORS     *
**************************************************************************************************
     1        4-1           115.62                              159.51                            1076.
     1        4-2            95.03                              138.17                             992.
     1        4-3            70.20                              101.95                             777.
     1        4-4            71.83                              107.80                            1160.
              SUM           352.77                              507.43                            4005.
            AVERAGE          88.19                              126.86                            1001.



     2        4-1           117.62                              169.95                            1682.
     2        4-2            90.65                              122.04                            1558.
     2        4-3            65.25                               94.51                            1174.
     2        4-4            59.06                               80.80                            1223.
              SUM           332.59                              467.30                            5637.
            AVERAGE          83.15                              116.83                            1409.



     3        4-1            83.27                              113.35                            1069.
     3        4-2            66.20                               89.72                            1088.
     3        4-3            73.71                               92.36                            1126.
     3        4-4            48.45                               67.66                             916.
              SUM           271.63                              363.09                            4199.
            AVERAGE          67.91                               90.77                            1050.



     4        4-1            73.08                               99.79                             823.
     4        4-2            75.52                               95.49                             977.
     4        4-3            60.13                               79.94                             877.
     4        4-4            22.37                               30.00                             327.
              SUM           231.09                              305.23                            3004.
            AVERAGE          57.77                               76.31                             751.

  CUMULATIVE SUM           1188.08                             1643.06                           16845.
  CUMULATIVE AVERAGE         74.25                              102.69                            1053.
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ROCKFORD, ILLINOIS  SYSTEM NUMBER 4 ROUTE(4/1-4) QUARTERS 1-4 12/12/72-9/14/73

                                                              ROUTE CUMULATIVES
                                                     ***********************************

           *ALL TIMES ARE IN MINUTES*                   4-1      4-2      4-3      4-4
                                                     ***********************************
                                                              *        *        *

1) TIME EFFICIENCY OF CREW WHILE COLLECTING        = 89.45% * 92.08% * 88.84% * 88.92%
   ON ROUTE                                                 *        *        *
2) UTILIZATION OF DRIVERS TIME   A) DRIVING        = 28.66% * 28.83% * 26.85% * 29.11%
                                 B) WALKING        =  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING        = 64.89% * 54.46% * 61.35% * 43.76%
                                 D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER          =  0.88% *  0.26% *  0.00% *  0.50%
                                 F) COLLECTION=  5.58% * 16.45% * 11.81% * 26.63%
3) UTILIZATION OF COLLECTORS     A) RIDING         = 20.48% * 16.84% * 17.20% * 13.99%
   TIME                          B) WALKING        =  4.74% *  7.56% *  6.74% * 12.28%
                                 C) WAITING        =  0.91% *  0.80% *  0.57% *  1.16%
                                 D) COMPACTION=  8.74% *  6.58% * 10.11% *  8.78%
                                 E) OTHER          =  0.89% *  0.54% *  0.47% *  1.13%
                                 F) COLLECTION= 64.23% * 67.68% * 64.90% * 62.66%
4) AVERAGE NUMBER OF ITEMS       A) CANS           =  1.37  *  1.26  *  1.02  *  0.99
   BY TYPE / SERVICE             B) SMALL CANS=  0.10  *  0.20  *  0.12  *  0.25
                                 C) BAGS           =  2.62  *  2.99  *  2.32  *  2.55
                                 D) MISC.          =  0.69  *  0.66  *  0.81  *  0.70
5) RETURNABLE / NON-RETURNABLE   A) RETURN         =  1.48  *  1.47  *  1.14  *  1.24
   ITEMS / SERVICE               B) NO RET         =  3.31  *  3.65  *  3.13  *  3.25
6) AVERAGE NUMBER OF DWELLINGS / SERVICE           =  1.07  *  1.11  *  1.03  *  1.06
7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)         =162.89  *122.30  *109.70  *115.11
8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME          =  0.89  *  0.92  *  0.89  *  0.89
9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME       =  0.72  *  0.74  *  0.73  *  0.70
14) DUPLICATION OF HANDLING                        =  0.82% *  1.23% *  0.43% *  0.33%
15) A) TOTAL CREW TIME / DWELLING                  =  0.59  *  0.49  *  0.44  *  0.38
    B) HANDLING TIME / DWELLING                    =  0.38  *  0.33  *  0.28  *  0.24
    C) PRODUCTIVE TIME / DWELLING                  =  0.52  *  0.45  *  0.39  *  0.33
    D) CANS / DWELLING                             =  1.28  *  1.13  *  0.99  *  0.93
    E) SMALL CANS / DWELLING                       =  0.10  *  0.18  *  0.11  *  0.23
    F) BAGS / DWELLING                             =  2.44  *  2.88  *  2.24  *  2.40
    G) MISCELLANEOUS / DWELLING                    =  0.64  *  0.59  *  0.79  *  0.66
    H) RETURNABLES / DWELLING                      =  1.38  *  1.32  *  1.10  *  1.16
    I) NON-RETURNABLES / DWELLING                  =  3.08  *  3.28  *  3.03  *  3.06
```

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ROCKFORD, ILLINOIS  SYSTEM NUMBER 4   ROUTE(4/1-4)  4TH QUARTER 9/11/73-9/14/73

                                                            SYSTEM PERFORMANCE
                                                 ***************************************************
                                                              BY QUARTER                   CUMU-
            *ALL TIMES ARE IN MINUTES*                1ST       2ND       3RD       4TH     LATIVE
                                                 ***************************************************
                                                          *         *         *         *

 1) TIME EFFICIENCY OF CREW WHILE COLLECTING    = 92.51% * 87.02% * 87.05% * 93.98% * 89.91%
    ON ROUTE                                              *         *         *         *

 2) UTILIZATION OF DRIVERS TIME  A) DRIVING    = 32.04% * 29.73% * 24.83% * 24.53% * 28.37%
                                 B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING    = 56.95% * 56.86% * 55.64% * 62.24% * 57.57%
                                 D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER      =  0.90% *  0.16% *  0.38% *  0.23% *  0.44%
                                 F) COLLECTION= 10.11% * 13.25% * 19.15% * 13.00% * 13.62%

 3) UTILIZATION OF COLLECTORS    A) RIDING     = 21.40% * 16.43% * 13.82% * 18.13% * 17.63%
    TIME                         B) WALKING    =  6.79% *  8.66% *  8.11% *  4.70% *  7.27%
                                 C) WAITING    =  0.06% *  1.55% *  1.30% *  0.44% *  0.85%
                                 D) COMPACTION=  6.85% * 10.57% * 10.63% *  5.08% *  8.49%
                                 E) OTHER      =  0.58% *  0.86% *  1.02% *  0.51% *  0.75%
                                 F) COLLECTION= 64.31% * 61.94% * 65.12% * 71.15% * 65.02%

 4) AVERAGE NUMBER OF ITEMS      A) CANS       =  1.17  *  1.15  *  1.22  *  1.14  *  1.17
    BY TYPE / SERVICE            B) SMALL CANS=  0.12  *  0.14  *  0.23  *  0.18  *  0.16
                                 C) BAGS       =  2.68  *  2.60  *  2.62  *  2.56  *  2.62
                                 D) MISC.      =  0.58  *  0.67  *  0.85  *  0.91  *  0.72

 5) RETURNABLE / NON-RETURNABLE  A) RETURN     =  1.29  *  1.29  *  1.45  *  1.32  *  1.33
    ITEMS / SERVICE              B) NO RET     =  3.26  *  3.27  *  3.47  *  3.37  *  3.33

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE      =  1.14  *  1.07  *  1.02  *  1.05  *  1.07

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)    = 163.90 * 122.90 * 105.60 * 116.81 * 128.51

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME     =  0.93  *  0.87  *  0.87  *  0.94  *  0.90

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME =  0.70  *  0.71  *  0.75  *  0.76  *  0.72

14) DUPLICATION OF HANDLING                    =  1.14% *  0.95% *  0.53% *  0.10% *  0.76%

15) A) TOTAL CREW TIME / DWELLING              =  0.55  *  0.41  *  0.48  *  0.49  *  0.48
    B) HANDLING TIME / DWELLING                =  0.36  *  0.25  *  0.31  *  0.35  *  0.31
    C) PRODUCTIVE TIME / DWELLING              =  0.51  *  0.36  *  0.42  *  0.46  *  0.43
    D) CANS / DWELLING                         =  1.03  *  1.07  *  1.19  *  1.09  *  1.09
    E) SMALL CANS / DWELLING                   =  0.10  *  0.13  *  0.23  *  0.17  *  0.15
    F) BAGS / DWELLING                         =  2.35  *  2.43  *  2.57  *  2.45  *  2.45
    G) MISCELLANEOUS / DWELLING                =  0.51  *  0.62  *  0.84  *  0.77  *  0.67
    H) RETURNABLES / DWELLING                  =  1.14  *  1.20  *  1.42  *  1.26  *  1.25
    I) NON-RETURNABLES / DWELLING              =  2.87  *  3.05  *  3.41  *  3.22  *  3.11
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FLINT, MICHIGAN   SYSTEM NUMBER 5   ROUTE(5/1-4)   4TH QUARTER   7/10-13/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE				NUMBER OF RETURN-ABLE ITEMS	NUMBER OF NON RETURN-ABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
				CANS	SMALL CANS	BAGS	MISCEL-LANEOUS				
1	5-1	235.	235.	0.	85.	1086.	66.	85.	1152.	1237.	7.00
1	5-2	208.	208.	3.	116.	826.	86.	119.	912.	1031.	3.36
1	5-3	251.	253.	0.	138.	975.	97.	138.	1072.	1210.	10.70
1	5-4	305.	306.	0.	116.	1446.	151.	116.	1597.	1713.	10.72
SUM		999.	1002.	3.	455.	4333.	400.	458.	4733.	5191.	31.78
AVERAGE		250.	250.	1.	114.	1083.	100.	114.	1183.	1298.	7.94
2	5-1	193.	193.	0.	53.	591.	56.	53.	647.	700.	6.20
2	5-2	238.	243.	0.	60.	887.	50.	60.	937.	997.	10.20
2	5-3	230.	233.	0.	71.	858.	52.	71.	910.	981.	6.60
2	5-4	164.	164.	0.	58.	575.	59.	58.	634.	692.	5.00
SUM		825.	833.	0.	242.	2911.	217.	242.	3128.	3370.	28.00
AVERAGE		206.	208.	0.	60.	728.	54.	60.	782.	842.	7.00
3	5-1	198.	199.	0.	49.	831.	86.	49.	917.	966.	5.60
3	5-2	235.	241.	0.	77.	967.	80.	77.	1047.	1124.	7.20
3	5-3	168.	169.	0.	84.	779.	123.	84.	902.	986.	4.60
3	5-4	265.	265.	0.	85.	1234.	162.	85.	1400.	1485.	8.50
SUM		866.	874.	0.	295.	3811.	451.	295.	4266.	4561.	25.90
AVERAGE		216.	218.	0.	74.	953.	113.	74.	1066.	1140.	6.47
4	5-1	147.	147.	1.	45.	415.	72.	46.	487.	533.	4.90
4	5-2	159.	170.	0.	50.	1284.	89.	50.	1373.	1423.	3.70
4	5-3	165.	166.	0.	89.	1199.	171.	89.	1370.	1459.	3.80
4	5-4	83.	83.	1.	23.	823.	85.	24.	908.	932.	3.40
SUM		554.	566.	2.	207.	3721.	417.	209.	4138.	4347.	15.80
AVERAGE		138.	141.	1.	52.	930.	104.	52.	1034.	1087.	3.95
CUMULATIVE SUM		3244.	3275.	5.	1199.	14776.	1485.	1204.	16265.	17469.	101.48
CUMULATIVE AVERAGE		203.	205.	0.	75.	923.	93.	75.	1017.	1092.	6.34

FLINT, MICHIGAN SYSTEM NUMBER 5 ROUTE(5/1-4) 4TH QUARTER 7/10-13/73

TIME & MOTION DATA REDUCTION

		DRIVERS TIME (MINUTES)				COLLECTORS TIME (MINUTES)					
QUARTER	ROUTE	DRIVING	WAITING	COLLECT	OTHER	TOTAL TIME	RIDING	WALKING	WAITING	COMPACT	OTHER
1	5-1	29.17	52.98	4.77	1.25	88.40	24.96	3.63	0.03	11.03	0.00
1	5-2	23.02	52.19	0.00	0.19	76.27	23.07	0.31	0.62	11.85	0.00
1	5-3	41.46	71.35	1.77	0.72	109.74	36.42	2.25	1.69	10.29	0.71
1	5-4	48.43	58.29	4.60	0.93	112.20	47.19	5.58	0.00	6.11	0.52
SUM		142.09	234.82	11.13	3.09	386.61	131.64	11.78	2.34	39.28	1.23
AVERAGE		35.52	58.70	2.78	0.77	96.65	32.91	2.94	0.59	9.82	0.31
2	5-1	26.04	29.26	0.00	0.19	55.39	21.97	1.17	0.32	5.90	0.00
2	5-2	35.54	50.03	0.00	0.00	83.87	34.10	0.10	0.15	12.08	0.00
2	5-3	33.22	50.39	0.00	0.33	82.96	29.33	0.84	0.79	11.20	0.21
2	5-4	21.76	23.08	0.27	0.00	45.10	19.01	1.68	0.12	1.91	0.00
SUM		116.55	152.77	0.27	0.52	267.32	104.42	3.79	1.39	31.10	0.21
AVERAGE		29.14	38.19	0.07	0.13	66.83	26.11	0.95	0.35	7.78	0.05
3	5-1	24.20	37.18	0.42	0.00	61.37	22.18	0.45	0.00	9.40	0.00
3	5-2	31.38	56.42	0.00	0.00	87.84	28.54	0.56	0.30	12.98	0.11
3	5-3	24.89	58.95	0.00	0.00	83.84	21.10	1.05	0.12	12.22	0.00
3	5-4	35.00	52.78	0.00	0.00	87.73	34.79	0.88	0.00	3.34	0.00
SUM		115.46	205.33	0.42	0.00	320.78	106.61	2.94	0.42	37.95	0.11
AVERAGE		28.87	51.33	0.10	0.00	80.19	26.65	0.73	0.11	9.49	0.03
4	5-1	19.72	36.18	0.00	0.00	55.93	17.32	0.29	0.00	5.34	0.00
4	5-2	19.67	61.10	0.00	0.00	86.85	16.08	0.78	0.00	10.11	0.00
4	5-3	23.48	94.66	0.00	0.00	117.16	19.62	1.85	0.56	11.88	0.19
4	5-4	16.13	47.81	0.00	0.00	63.93	14.34	0.20	0.97	8.17	0.32
SUM		79.00	239.75	0.00	0.00	323.87	67.36	3.12	1.53	35.51	0.51
AVERAGE		19.75	59.94	0.00	0.00	80.97	16.84	0.78	0.38	8.88	0.13
CUMULATIVE SUM		453.11	832.67	11.82	3.61	1298.57	410.04	21.63	5.69	143.84	2.06
CUMULATIVE AVERAGE		28.32	52.04	0.74	0.23	81.16	25.63	1.35	0.36	8.99	0.13

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              FLINT, MICHIGAN     SYSTEM NUMBER 5   ROUTE(5/1-4)  4TH QUARTER   7/10-13/73

                                        TIME & MOTION DATA REDUCTION

***************************************************************************************************
*         *           *                 *                *              *              *          *
*         *           * TOTAL HANDLING  * RATIO OF       *    TOTAL     * RATIO OF     *          *
*         *           *      TIME       * HANDLING TIME  *  PRODUCTIVE  * PRODUCTIVE   * TOTAL ITEMS *
* QUARTER *   ROUTE   *    (MINUTES)    * TO TOTAL TIME  *     TIME     * TIME TO      * HANDLED BY *
*         *           *                 *                *   (MINUTES)  * TOTAL TIME   * COLLECTORS *
***************************************************************************************************
     1         5-1          48.74
     1         5-2          40.42                              77.34                         1237.
     1         5-3          58.37                              63.80                         1031.
     1         5-4          52.80                              97.04                         1210.
               SUM         200.33                             105.57                         1713.
             AVERAGE        50.08                             343.75                         5191.
                                                               85.94                         1298.


     2         5-1          26.02
     2         5-2          37.43                              49.17                          703.
     2         5-3          40.59                              71.63                          997.
     2         5-4          22.37                              70.76                          981.
               SUM         126.40                              43.06                          692.
             AVERAGE        31.60                             234.62                         3373.
                                                               58.65                          843.


     3         5-1          29.34
     3         5-2          45.34                              51.97                          966.
     3         5-3          49.35                              74.44                         1128.
     3         5-4          48.70                              71.50                          989.
               SUM         172.74                              84.38                         1493.
             AVERAGE        43.18                             282.29                         4576.
                                                               70.57                         1144.


     4         5-1          32.98
     4         5-2          59.87                              50.58                          533.
     4         5-3          83.06                              76.73                         1423.
     4         5-4          39.94                             104.53                         1459.
               SUM         215.84                              54.48                          932.
             AVERAGE        53.96                             286.32                         4347.
                                                               71.58                         1087.

 CUMULATIVE SUM            715.32
 CUMULATIVE AVERAGE         44.71                            1146.99                        17487.
                                                               71.69                         1093.
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          FLINT, MICHIGAN     SYSTEM NUMBER 5   ROUTE(1/1-4)  QUARTERS 1-4 7/13/73


                                                            ROUTE CUMULATIVES
                                                    ****************************************

          *ALL TIMES ARE IN MINUTES*                   5-1        5-2        5-3        5-4
                                                    ****************************************
                                                              *          *          *

 1) TIME EFFICIENCY OF CREW WHILE COLLECTING    = 87.74% * 85.60% * 87.33% * 93.05%
    ON ROUTE                                              *          *          *
 2) UTILIZATION OF DRIVERS TIME  A) DRIVING     = 37.93% * 33.26% * 30.67% * 39.25%
                                 B) WALKING     =  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING     = 59.54% * 66.68% * 68.63% * 58.87%
                                 D) COMPACTION=    0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER       =  0.55% *  0.06% *  0.26% *  0.30%
                                 F) COLLECTION=    1.98% *  0.00% *  0.44% *  1.58%
 3) UTILIZATION OF COLLECTORS    A) RIDING      = 33.11% * 30.40% * 27.04% * 37.33%
    TIME                         B) WALKING     =  2.12% *  0.53% *  1.52% *  2.70%
                                 C) WAITING     =  0.13% *  0.32% *  0.81% *  0.35%
                                 D) COMPACTION=   12.14% * 14.04% * 11.58% *  6.33%
                                 E) OTHER       =  0.00% *  0.03% *  0.28% *  0.27%
                                 F) COLLECTION=   52.50% * 54.67% * 58.77% * 53.02%
 4) AVERAGE NUMBER OF ITEMS      A) CANS        =  0.00  *  0.00  *  0.00  *  0.00
    BY TYPE / SERVICE            B) SMALL CANS=    0.30  *  0.36  *  0.47  *  0.35
                                 C) BAGS        =  3.78  *  4.72  *  4.68  *  4.99
                                 D) MISC.       =  0.36  *  0.36  *  0.54  *  0.56
 5) RETURNABLE / NON-RETURNABLE  A) RETURN      =  0.30  *  0.36  *  0.47  *  0.35
    ITEMS / SERVICE              B) NO RET      =  4.14  *  5.08  *  5.23  *  5.56
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE       =  1.00  *  1.03  *  1.01  *  1.00
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)     =161.67  *149.82  *165.28  *178.28
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME      =  0.88  *  0.86  *  0.87  *  0.93
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME   =  0.60  *  0.64  *  0.67  *  0.57
14) DUPLICATION OF HANDLING                     =  0.09% *  0.09% *  0.06% *  0.17%
15) A) TOTAL CREW TIME / DWELLING               =  0.34  *  0.39  *  0.48  *  0.38
    B) HANDLING TIME / DWELLING                 =  0.18  *  0.21  *  0.28  *  0.20
    C) PRODUCTIVE TIME / DWELLING               =  0.30  *  0.33  *  0.42  *  0.35
    D) CANS / DWELLING                          =  0.00  *  0.00  *  0.00  *  0.00
    E) SMALL CANS / DWELLING                    =  0.30  *  0.35  *  0.47  *  0.34
    F) BAGS / DWELLING                          =  3.78  *  4.60  *  4.64  *  4.99
    G) MISCELLANEOUS / DWELLING                 =  0.36  *  0.35  *  0.54  *  0.56
    H) RETURNABLES / DWELLING                   =  0.30  *  0.35  *  0.47  *  0.35
    I) NON-RETURNABLES / DWELLING               =  4.14  *  4.95  *  5.18  *  5.55
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FLINT, MICHIGAN     SYSTEM NUMBER 5   ROUTE(5/1-4)  4TH QUARTER  7/10-13/73

                                                      SYSTEM PERFORMANCE
                                               ****************************************
                                                         BY QUARTER                CUMU-
         *ALL TIMES ARE IN MINUTES*                1ST       2ND       3RD      4TH   LATIVE
                                               ****************************************
                                                         *         *         *         *

1) TIME EFFICIENCY OF CREW WHILE COLLECTING  = 88.91% * 87.77% * 88.00% * 88.41% * 88.33%
   ON ROUTE                                          *         *         *         *

2) UTILIZATION OF DRIVERS TIME     A) DRIVING    = 36.33% * 43.15% * 35.95% * 24.78% * 34.82%
                                   B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   C) WAITING    = 60.04% * 56.56% * 63.92% * 75.22% * 63.99%
                                   D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   E) OTHER      =  0.79% *  0.19% *  0.00% *  0.00% *  0.28%
                                   F) COLLECTION=  2.85% *  0.10% *  0.13% *  0.00% *  0.91%

3) UTILIZATION OF COLLECTORS       A) RIDING     = 34.05% * 39.06% * 33.24% * 20.80% * 31.58%
   TIME                            B) WALKING    =  3.05% *  1.42% *  0.92% *  0.96% *  1.67%
                                   C) WAITING    =  0.61% *  0.52% *  0.13% *  0.47% *  0.44%
                                   D) COMPACTION= 10.16% * 11.63% * 11.83% * 10.96% * 11.08%
                                   E) OTHER      =  0.32% *  0.08% *  0.04% *  0.16% *  0.16%
                                   F) COLLECTION= 51.82% * 47.29% * 53.85% * 66.65% * 55.09%

4) AVERAGE NUMBER OF ITEMS         A) CANS       =  0.00  *  0.00  *  0.00  *  0.00  *  0.00
   BY TYPE / SERVICE               B) SMALL CANS=  0.46  *  0.29  *  0.34  *  0.37  *  0.37
                                   C) BAGS       =  4.34  *  3.53  *  4.40  *  6.72  *  4.55
                                   D) MISC.      =  0.40  *  0.26  *  0.52  *  0.75  *  0.46

5) RETURNABLE / NON-RETURNABLE     A) RETURN     =  0.46  *  0.29  *  0.34  *  0.38  *  0.37
   ITEMS / SERVICE                 B) NO RET     =  4.74  *  3.79  *  4.93  *  7.47  *  5.01

6) AVERAGE NUMBER OF DWELLINGS / SERVICE         =  1.00  *  1.01  *  1.01  *  1.02  *  1.01

7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)       = 167.46 * 177.48 * 156.47 * 147.39 * 163.61

8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME        =  0.89  *  0.88  *  0.88  *  0.88  *  0.88

9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME     =  0.58  *  0.54  *  0.61  *  0.75  *  0.62

14) DUPLICATION OF HANDLING                      =  0.00% *  0.09% *  0.33% *  0.00% *  0.10%

15) A) TOTAL CREW TIME / DWELLING                =  0.39  *  0.32  *  0.37  *  0.57  *  0.40
    B) HANDLING TIME / DWELLING                  =  0.20  *  0.15  *  0.20  *  0.38  *  0.22
    C) PRODUCTIVE TIME / DWELLING                =  0.34  *  0.28  *  0.32  *  0.51  *  0.35
    D) CANS / DWELLING                           =  0.00  *  0.00  *  0.00  *  0.00  *  0.00
    E) SMALL CANS / DWELLING                     =  0.45  *  0.29  *  0.34  *  0.37  *  0.37
    F) BAGS / DWELLING                           =  4.32  *  3.49  *  4.36  *  6.57  *  4.51
    G) MISCELLANEOUS / DWELLING                  =  0.40  *  0.26  *  0.52  *  0.74  *  0.45
    H) RETURNABLES / DWELLING                    =  0.46  *  0.29  *  0.34  *  0.37  *  0.37
    I) NON-RETURNABLES / DWELLING                =  4.72  *  3.76  *  4.88  *  7.31  *  4.97
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TUCSON, ARIZ.   SYSTEM NUMBER 6 ROUTE (6/1-4) 4TH QUARTER 10/1/73-10/5/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE				NUMBER OF RETURN-ABLE ITEMS	NUMBER OF NON RETURN-ABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
				CANS	SMALL CANS	BAGS	MISCEL-LANEOUS				
1	6-1	151.	152.	245.	27.	83.	110.	272.	193.	465.	6.70
1	6-2	133.	134.	151.	10.	61.	60.	161.	121.	282.	5.50
1	6-3	167.	173.	243.	18.	75.	68.	261.	143.	404.	7.40
1	6-4	155.	156.	182.	10.	47.	74.	192.	121.	313.	6.20
SUM		606.	615.	821.	65.	266.	312.	886.	578.	1464.	25.80
AVERAGE		151.	154.	205.	16.	66.	78.	221.	144.	366.	6.45
2	6-1	118.	118.	217.	9.	73.	107.	226.	180.	406.	4.60
2	6-2	120.	120.	145.	12.	52.	57.	157.	109.	266.	4.10
2	6-3	112.	113.	179.	15.	64.	54.	194.	118.	312.	3.80
2	6-4	133.	133.	155.	4.	46.	32.	159.	78.	237.	3.80
SUM		483.	484.	696.	40.	235.	250.	736.	485.	1221.	16.30
AVERAGE		121.	121.	174.	10.	59.	63.	184.	121.	305.	4.07
3	6-1	164.	164.	352.	29.	70.	116.	373.	183.	556.	6.00
3	6-2	146.	146.	118.	10.	143.	54.	127.	194.	321.	6.10
3	6-3	147.	147.	227.	20.	41.	79.	247.	120.	367.	5.76
3	6-4	104.	104.	111.	8.	79.	23.	119.	102.	221.	5.60
SUM		561.	561.	808.	67.	333.	272.	866.	599.	1465.	23.46
AVERAGE		140.	140.	202.	17.	83.	68.	216.	150.	366.	5.86
4	6-1	79.	80.	149.	11.	50.	41.	156.	91.	247.	4.10
4	6-2	154.	154.	183.	15.	88.	67.	198.	146.	344.	6.20
4	6-3	146.	146.	230.	21.	45.	72.	251.	117.	368.	6.70
4	6-4	74.	74.	104.	3.	36.	19.	109.	55.	164.	1.80
SUM		453.	454.	666.	50.	219.	199.	714.	409.	1123.	18.80
AVERAGE		113.	113.	166.	13.	55.	50.	178.	102.	281.	4.70
CUMULATIVE SUM		2103.	2114.	2991.	222.	1053.	1033.	3202.	2071.	5273.	84.36
CUMULATIVE AVERAGE		131.	132.	187.	14.	66.	65.	200.	129.	330.	5.27

TUCSON, ARIZ. SYSTEM NUMBER 6 ROUTE (6/1-4) 4TH QUARTER 10/1/73-10/5/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	DRIVERS TIME (MINUTES)				COLLECTORS TIME (MINUTES)					
		DRIVING	WAITING	COLLECT	OTHER	TOTAL TIME	RIDING	WALKING	WAITING	COMPACT	OTHER
1	6-1	24.02	0.00	0.00	44.17	136.74	38.08	0.03	1.64	3.83	0.20
1	6-2	22.54	0.00	0.00	25.88	97.96	34.18	1.28	1.22	0.86	0.00
1	6-3	28.15	0.00	0.00	36.71	130.03	47.08	0.06	2.71	0.38	0.00
1	6-4	24.30	0.00	0.00	27.39	103.44	40.56	1.53	0.00	0.28	0.00
	SUM	99.01	0.00	0.00	134.15	468.17	159.90	2.91	5.57	5.35	0.20
	AVERAGE	24.75	0.00	0.00	33.54	117.04	39.98	0.73	1.39	1.34	0.05
2	6-1	19.53	0.00	0.00	38.09	115.34	34.42	0.37	0.00	0.67	0.10
2	6-2	15.56	0.00	0.00	20.77	72.68	27.09	0.95	0.00	0.46	0.00
2	6-3	17.91	0.00	0.00	27.63	91.13	31.75	0.04	0.70	0.09	0.41
2	6-4	17.91	0.00	0.00	18.97	73.77	32.40	0.75	0.16	0.24	0.00
	SUM	70.91	0.00	0.00	105.46	352.92	125.66	2.12	0.86	1.46	0.51
	AVERAGE	17.73	0.00	0.00	26.36	88.23	31.42	0.53	0.22	0.33	0.13
3	6-1	24.27	0.00	0.00	39.98	128.48	41.53	0.85	3.18	0.18	0.28
3	6-2	19.56	0.00	0.00	25.30	87.49	33.85	0.74	2.55	0.05	0.00
3	6-3	21.16	0.00	0.00	35.27	112.85	50.86	0.21	3.76	0.22	0.00
3	6-4	18.70	0.00	0.00	17.84	74.07	23.98	0.06	2.65	0.00	0.00
	SUM	83.69	0.00	0.00	118.39	402.89	150.22	1.86	12.15	0.45	0.28
	AVERAGE	20.92	0.00	0.00	29.60	100.72	37.55	0.47	3.04	0.11	0.07
4	6-1	13.43	0.00	0.00	22.50	71.51	26.53	0.21	14.59	0.00	0.00
4	6-2	22.55	5.67	0.00	25.03	106.00	46.50	0.00	19.13	0.17	0.00
4	6-3	25.38	0.00	0.00	32.30	115.37	50.51	0.16	16.64	0.00	0.00
4	6-4	8.95	0.00	0.00	17.33	52.57	17.94	0.33	11.38	0.00	0.00
	SUM	70.32	5.67	0.00	97.16	345.44	141.48	0.71	61.75	0.17	0.00
	AVERAGE	17.58	1.42	0.00	24.29	86.36	35.37	0.18	15.44	0.04	0.00
CUMULATIVE SUM		323.92	5.67	0.00	455.16	1569.42	577.26	7.60	80.33	7.43	0.99
CUMULATIVE AVERAGE		20.25	0.35	0.00	28.45	98.09	36.08	0.47	5.02	0.46	0.06

TUCSON, ARIZ.   SYSTEM NUMBER 6 ROUTE (6/1-4) 4TH QUARTER 10/1/73-10/5/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	TOTAL HANDLING TIME (MINUTES)	RATIO OF HANDLING TIME TO TOTAL TIME	TOTAL PRODUCTIVE TIME (MINUTES)	RATIO OF PRODUCTIVE TIME TO TOTAL TIME	TOTAL ITEMS HANDLED BY COLLECTORS
1	6-1	92.96		131.08		475.
1	6-2	60.43		95.88		283.
1	6-3	79.79		126.93		411.
1	6-4	61.06		103.16		325.
	SUM	294.24		457.05		1494.
	AVERAGE	73.56		114.26		373.
2	6-1	79.77		114.57		415.
2	6-2	44.17		72.22		281.
2	6-3	58.15		89.93		320.
2	6-4	40.21		73.36		240.
	SUM	222.30		350.09		1256.
	AVERAGE	55.58		87.52		314.
3	6-1	82.45		124.83		578.
3	6-2	50.30		84.88		327.
3	6-3	57.80		108.87		375.
3	6-4	47.38		71.42		221.
	SUM	237.93		390.01		1501.
	AVERAGE	59.48		97.50		375.
4	6-1	30.18		56.92		250.
4	6-2	40.19		86.69		355.
4	6-3	48.05		98.72		371.
4	6-4	22.91		41.18		165.
	SUM	141.33		283.52		1141.
	AVERAGE	35.33		70.88		285.
CUMULATIVE SUM		895.81		1480.67		5392.
CUMULATIVE AVERAGE		55.99		92.54		337.

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TUCSON, ARIZ.  SYSTEM NUMBER 6 ROUTE(6/1-4)  QUARTERS 1-4  1/15/73-10/5/73

                                                          ROUTE CUMULATIVES
                                                  ************************************

          *ALL TIMES ARE IN MINUTES*                   6-1      6-2      6-3      6-4
                                                  ************************************
                                                          *        *        *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING    = 94.54% * 93.29% * 94.45% * 95.15%
    ON ROUTE                                              *        *        *
 2) UTILIZATION OF DRIVERS TIME  A) DRIVING     = 35.95% * 43.86% * 41.25% * 46.15%
                                 B) WALKING     =  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING     =  0.00% *  3.10% *  0.00% *  0.00%
                                 D) COMPACTION=    0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER       = 64.05% * 53.03% * 58.75% * 53.85%
                                 F) COLLECTION=    0.00% *  0.00% *  0.00% *  0.00%
 3) UTILIZATION OF COLLECTORS    A) RIDING      = 31.09% * 38.89% * 40.10% * 37.81%
    TIME                         B) WALKING     =  0.33% *  0.82% *  0.11% *  0.88%
                                 C) WAITING     =  4.29% *  6.29% *  5.30% *  4.67%
                                 D) COMPACTION=    1.03% *  0.42% *  0.15% *  0.17%
                                 E) OTHER       =  0.13% *  0.00% *  0.09% *  0.00%
                                 F) COLLECTION= 63.12% * 53.58% * 54.25% * 56.46%
 4) AVERAGE NUMBER OF ITEMS      A) CANS        =  1.88   *  1.08   *  1.54   *  1.18
    BY TYPE / SERVICE            B) SMALL CANS=    0.15   *  0.08   *  0.13   *  0.05
                                 C) BAGS        =  0.54   *  0.62   *  0.39   *  0.45
                                 D) MISC.       =  0.73   *  0.43   *  0.48   *  0.32
 5) RETURNABLE / NON-RETURNABLE  A) RETURN      =  2.01   *  1.16   *  1.67   *  1.24
    ITEMS / SERVICE              B) NO RET      =  1.26   *  1.03   *  0.87   *  0.76
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE       =  1.00   *  1.00   *  1.31   *  1.00
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)     =219.83   *208.72   *215.76   *196.73
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME      =  0.95   *  0.93   *  0.94   *  0.95
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME =    0.67   *  0.57   *  0.57   *  0.59
14) DUPLICATION OF HANDLING
                                                =  2.63% *  2.72% *  1.79% *  1.71%
15) A) TOTAL CREW TIME / DWELLING               =  0.88   *  0.66   *  0.78   *  0.65
    B) HANDLING TIME / DWELLING                 =  0.56   *  0.35   *  0.42   *  0.37
    C) PRODUCTIVE TIME / DWELLING               =  0.83   *  0.61   *  0.73   *  0.62
    D) CANS / DWELLING                          =  1.87   *  1.08   *  1.52   *  1.18
    E) SMALL CANS / DWELLING                    =  0.15   *  0.08   *  0.13   *  0.05
    F) BAGS / DWELLING                          =  0.54   *  0.62   *  0.39   *  0.45
    G) MISCELLANEOUS / DWELLING                 =  0.73   *  0.43   *  0.47   *  0.32
    H) RETURNABLES / DWELLING                   =  2.00   *  1.16   *  1.65   *  1.24
    I) NON-RETURNABLES / DWELLING               =  1.26   *  1.03   *  0.86   *  0.76
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      TUCSON, ARIZ.   SYSTEM NUMBER 6  ROUTE (6/1-4)  4TH QUARTER  10/1/73-10/5/73

                                                          SYSTEM PERFORMANCE
                                                  **********************************************
                                                              BY QUARTER                  CUMU-
            *ALL TIMES ARE IN MINUTES*                1ST       2ND       3RD       4TH     LATIVE
                                                  **********************************************
                                                           *         *         *         *

  1) TIME EFFICIENCY OF CREW WHILE COLLECTING   = 97.62% * 99.20% * 96.80% * 82.06% * 94.34%
     ON ROUTE                                            *        *        *        *

  2) UTILIZATION OF DRIVERS TIME   A) DRIVING    = 42.47% * 40.20% * 41.41% * 40.61% * 41.28%
                                   B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   C) WAITING    =  0.00% *  0.00% *  0.00% *  3.28% *  0.72%
                                   D) COMPACTION=   0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                   E) OTHER      = 57.53% * 59.80% * 58.59% * 56.11% * 58.00%
                                   F) COLLECTION=   0.00% *  0.00% *  0.00% *  0.00% *  0.00%

  3) UTILIZATION OF COLLECTORS     A) RIDING     = 34.15% * 35.61% * 37.28% * 40.96% * 36.78%
     TIME                          B) WALKING    =  0.62% *  0.60% *  0.46% *  0.20% *  0.48%
                                   C) WAITING    =  1.19% *  0.24% *  3.02% * 17.88% *  5.12%
                                   D) COMPACTION=   1.14% *  0.41% *  0.11% *  0.05% *  0.47%
                                   E) OTHER      =  0.04% *  0.14% *  0.07% *  0.00% *  0.06%
                                   F) COLLECTION= 62.85% * 62.99% * 59.06% * 40.91% * 57.08%

  4) AVERAGE NUMBER OF ITEMS       A) CANS       =  1.35  *  1.44  *  1.44  *  1.47  *  1.42
     BY TYPE / SERVICE             B) SMALL CANS=   0.11  *  0.08  *  0.12  *  0.11  *  0.11
                                   C) BAGS       =  0.44  *  0.49  *  0.59  *  0.48  *  0.50
                                   D) MISC.      =  0.51  *  0.52  *  0.48  *  0.44  *  0.49

  5) RETURNABLE / NON-RETURNABLE   A) RETURN     =  1.46  *  1.52  *  1.54  *  1.58  *  1.52
     ITEMS / SERVICE               B) NO RET     =  0.95  *  1.00  *  1.07  *  0.90  *  0.98

  6) AVERAGE NUMBER OF DWELLINGS / SERVICE       =  1.01  *  1.00  *  1.00  *  1.00  *  1.01

  7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)     = 221.50 * 177.82 * 220.80 * 216.64 * 210.70

  8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME      =  0.98  *  0.99  *  0.97  *  0.82  *  0.94

  9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME   =  0.64  *  0.63  *  0.61  *  0.50  *  0.61

 14) DUPLICATION OF HANDLING                     =  2.05% *  2.07% *  2.46% *  1.60% *  2.26%

 15) A) TOTAL CREW TIME / DWELLING               =  0.76  *  0.73  *  0.72  *  0.76  *  0.74
     B) HANDLING TIME / DWELLING                 =  0.48  *  0.46  *  0.42  *  0.31  *  0.42
     C) PRODUCTIVE TIME / DWELLING               =  0.74  *  0.72  *  0.70  *  0.62  *  0.70
     D) CANS / DWELLING                          =  1.33  *  1.44  *  1.44  *  1.47  *  1.42
     E) SMALL CANS / DWELLING                    =  0.11  *  0.08  *  0.12  *  0.11  *  0.11
     F) BAGS / DWELLING                          =  0.43  *  0.49  *  0.59  *  0.48  *  0.50
     G) MISCELLANEOUS / DWELLING                 =  0.51  *  0.52  *  0.48  *  0.44  *  0.49
     H) RETURNABLES / DWELLING                   =  1.44  *  1.52  *  1.54  *  1.57  *  1.51
     I) NON-RETURNABLES / DWELLING               =  0.94  *  1.00  *  1.07  *  0.90  *  0.98
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          WARWICK, RHODE ISLAND    SYSTEM NUMBER 7  ROUTE(7/1-4)  4TH QUARTER  8/14/73


                                       TIME & MOTION DATA REDUCTION

*******************************************************************************************************************
*          *          *            *             *                                    *         *         *             *
*          *          *            *             *               NUMBER               *         *         *             *
*          *          *            *             *              OF ITEMS              * NUMBER  * NUMBER  *             *
*          *          *            *             *              BY TYPE               *   OF    * OF NON  *             *
*          *          *   NUMBER   *   NUMBER    ************************************** RETURN-* RETURN-*             * ROUTE     *
*          *          *     OF     *     OF      *        * SMALL *        * MISCEL-  * ABLE    * ABLE    *   TOTAL     * DISTANCE  *
* QUARTER  *  ROUTE   *  SERVICES  *  DWELLINGS  * CANS   * CANS  * BAGS   * LANEOUS  * ITEMS   * ITEMS   *   ITEMS     * (MILES)   *
*******************************************************************************************************************
    1         7-1         182.          167.       273.     17.   1551.      235.       291.     1785.     2076.        5.60
    1         7-2         226.          228.       303.     24.    916.      223.       328.     1138.     1466.        6.20
    1         7-3         181.          182.       334.     16.   1532.      127.       350.     1659.     2009.       10.10
    1         7-4         157.          157.       227.     11.    826.      167.       238.     1013.     1251.        4.50
         SUM              746.          754.      1137.     68.   4825.      772.      1207.     5595.     6802.       26.40
       AVERAGE            186.          188.       284.     17.   1206.      193.       302.     1399.     1700.        6.60

    2         7-1         145.          145.       187.      9.    328.      158.       196.      476.      672.        4.00
    2         7-2         202.          205.       291.     16.    376.      127.       307.      503.      810.        4.90
    2         7-3         140.          140.       297.     10.    223.       75.       307.      298.      605.        6.90
    2         7-4         148.          148.       205.      6.    319.      113.       211.      432.      643.        4.00
         SUM              635.          638.       980.     41.   1246.      473.      1021.     1709.     2730.       19.80
       AVERAGE            159.          159.       245.     10.    311.      118.       255.      427.      682.        4.95

    3         7-1         126.          127.       143.     13.    363.      131.       156.      494.      650.        3.70
    3         7-2         148.          148.       185.     15.    336.      101.       200.      437.      637.        3.10
    3         7-3         136.          137.       271.      5.    280.       80.       276.      360.      636.        6.60
    3         7-4         118.          118.       177.      4.    386.       89.       181.      475.      656.        3.50
         SUM              528.          530.       776.     37.   1365.      401.       813.     1766.     2579.       16.90
       AVERAGE            132.          132.       194.      9.    341.      100.       203.      441.      645.        4.22

    4         7-1         118.          144.       159.     15.    434.      199.       174.      633.      807.        3.80
    4         7-2         153.          154.       198.     17.    392.      138.       215.      530.      745.        3.70
    4         7-3         150.          150.       201.     10.    484.      122.       211.      606.      817.        5.00
    4         7-4         132.          133.       160.     21.    487.      188.       181.      675.      856.        5.40
         SUM              553.          581.       718.     63.   1797.      647.       781.     2444.     3225.       17.90
       AVERAGE            138.          145.       179.     16.    449.      162.       195.      611.      806.        4.47

CUMULATIVE SUM           3612.         3710.      5090.    341.  12962.     3622.      5414.    16495.    21909.      122.00

CUMULATIVE AVERAGE        226.          232.       318.     21.    810.      226.       338.     1031.     1369.        7.62
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              WARWICK, RHODE ISLAND    SYSTEM NUMBER 7  ROUTE(7/1-4)  4TH QUARTER  8/14/73


                                       TIME & MOTION DATA REDUCTION

*****************************************************************************************************************
*          *            *                                        *                                                *
*          *            *              DRIVERS                   *     ,          COLLECTORS TIME                 *
*          *            *               TIME                     *                   (MINUTES)                    *
*          *            *             (MINUTES)                  **************************************************
*          *            ****************************************** TOTAL *         *         *         *          *
* QUARTER  *  ROUTE     * DRIVING * WAITING * COLLECT * OTHER  * TIME   * RIDING  * WALKING * WAITING * COMPACT * OTHER *
*****************************************************************************************************************
    1          7-1        27.64      109.64       0.00       0.00  274.51     44.79      9.82       1.33      23.28      1.64
    1          7-2        24.62      128.86       0.00       0.00  307.12     33.00     21.27       4.92      11.23      0.86
    1          7-3        32.14      102.74       0.00       1.42  272.69     53.96      6.28       5.09      22.86      0.17
    1          7-4        18.57       67.18       0.00       1.03  173.72     27.83     10.43       0.62      10.21      0.37
         SUM             102.98      408.42       0.00       2.45 1028.03    159.58     47.80      11.96      67.59      3.24
         AVERAGE          25.74      102.10       0.00       0.61  257.01     39.90     11.95       2.99      16.90      0.81



    2          7-1        16.21       38.07       0.00       0.00  108.74     26.32      6.50       4.14       6.28      0.00
    2          7-2        20.96       75.51       0.00       0.00  193.13     31.01     14.03       3.17      13.51      1.53
    2          7-3        22.26       39.71       0.00       0.52  125.21     36.39      6.47       2.47       7.63      0.06
    2          7-4        14.15       34.25       0.00       0.00   96.85     23.30      6.61       1.86       5.80      0.17
         SUM              73.59      187.54       0.00       0.52  523.94    117.03     33.60      11.65      33.22      1.77
         AVERAGE          18.40       46.89       0.00       0.13  130.98     29.26      8.40       2.91       8.31      0.44



    3          7-1        17.13       46.55       0.00       1.70  130.75     28.82      3.23       0.50      14.05      0.42
    3          7-2        12.35       58.43       0.00       1.87  142.97     17.51      8.36       0.69      12.04      1.70
    3          7-3        21.86       47.45       0.00       0.41  139.44     34.87      5.61       2.36       8.89      0.17
    3          7-4        12.91       43.49       0.00       0.00  113.48     18.77      4.53       2.00       6.35      1.07
         SUM              64.26      195.92       0.00       3.98  526.65     99.97     21.73       5.55      41.34      3.36
         AVERAGE          16.06       48.98       0.00       0.99  131.66     24.99      5.43       1.39      10.33      0.84



    4          7-1        18.26       56.66       1.50       0.00  166.68     30.89      4.45       0.10      22.98      1.25
    4          7-2        19.19       65.04       0.00       0.00  171.75     26.30     12.66       1.00       9.89      0.00
    4          7-3        16.14       49.51       0.00       0.00  131.27     26.51      6.61       0.00      11.38      1.10
    4          7-4        22.96       58.51       0.00       0.00  211.87     36.11     12.14       0.73       4.75      0.58
         SUM              76.54      229.71       1.50       0.00  681.56    119.81     35.86       1.83      49.00      2.93
         AVERAGE          19.14       57.43       0.38       0.00  170.39     29.95      8.97       0.46      12.25      0.73

CUMULATIVE SUM           481.95     1495.67       4.50       6.95 4258.09    754.76    216.30      34.65     291.63     17.16
CUMULATIVE AVERAGE        30.12       93.48       0.28       0.43  266.13     47.17     13.52       2.17      18.23      1.07
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WARWICK, RHODE ISLAND   SYSTEM NUMBER 7 ROUTE(7/1-4) 4TH QUARTER 8/14/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	TOTAL HANDLING TIME (MINUTES)	RATIO OF HANDLING TIME TO TOTAL TIME	TOTAL PRODUCTIVE TIME (MINUTES)	RATIO OF PRODUCTIVE TIME TO TOTAL TIME	TOTAL ITEMS HANDLED BY COLLECTORS
1	7-1	193.45		248.06		2212.
1	7-2	235.63		290.10		1552.
1	7-3	184.32		244.57		2421.
1	7-4	124.25		162.51		1368.
	SUM	737.86		945.24		7553.
	AVERAGE	184.46		236.31		1888.
2	7-1	65.49		98.31		749.
2	7-2	129.67		174.91		852.
2	7-3	72.19		115.05		650.
2	7-4	59.11		89.03		697.
	SUM	326.66		477.30		2948.
	AVERAGE	81.67		119.32		737.
3	7-1	83.74		115.78		708.
3	7-2	102.67		128.54		664.
3	7-3	87.54		128.01		701.
3	7-4	80.75		104.05		694.
	SUM	354.69		476.39		2767.
	AVERAGE	88.67		119.10		692.
4	7-1	107.01		142.35		885.
4	7-2	121.90		160.86		753.
4	7-3	85.66		118.78		830.
4	7-4	157.56		205.81		873.
	SUM	472.13		627.81		3341.
	AVERAGE	118.03		156.95		835.
CUMULATIVE SUM		2943.59		3914.65		23525.
CUMULATIVE AVERAGE		183.97		244.67		1470.

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WARWICK, RHODE ISLAND     SYSTEM NUMBER 7  ROUTE(7/1-4)  4TH QUARTER  8/14/73

                                                          ROUTE CUMULATIVES
                                                *************************************

      *ALL TIMES ARE IN MINUTES*                     7-1        7-2        7-3        7-4
                                                *************************************
                                                            *        .  *          *

1) TIME EFFICIENCY OF CREW WHILE COLLECTING     = 88.81% *  92.57% *  90.70% *  94.21%
   ON ROUTE                                               *          *          *
2) UTILIZATION OF DRIVERS TIME  A) DRIVING      = 23.77% *  18.96% *  27.65% *  25.12%
                                B) WALKING      =  0.00% *   0.00% *   0.00% *   0.00%
                                C) WAITING      = 75.27% *  80.58% *  71.64% *  74.50%
                                D) COMPACTION=     0.00% *   0.00% *   0.00% *   0.00%
                                E) OTHER        =  0.51% *   0.46% *   0.70% *   0.38%
                                F) COLLECTION=     0.45% *   0.00% *   0.00% *   0.00%
3) UTILIZATION OF COLLECTORS    A) RIDING       = 19.22% *  13.23% *  22.69% *  17.79%
   TIME                         B) WALKING      =  3.53% *   6.91% *   3.73% *   5.66%
                                C) WAITING      =  0.89% *   1.20% *   1.48% *   0.87%
                                D) COMPACTION=     9.78% *   5.73% *   7.59% *   4.55%
                                E) OTHER        =  0.52% *   0.50% *   0.22% *   0.37%
                                F) COLLECTION=    66.06% *  72[illegible]% *  64.27% *  70.76%
4) AVERAGE NUMBER OF ITEMS      A) CANS         =  1.33  *  [illegible] *   1.82  *   1.39
   BY TYPE / SERVICE            B) SMALL CANS=     0.09  *  [illegible] *   0.07  *   0.08
                                C) BAGS         =  4.69  *  [illegible] *   4.15  *   3.64
                                D) MISC.        =  1.27  *  [illegible] *   0.67  *   1.04
5) RETURNABLE / NON-RETURNABLE  A) RETURN       =  1.43  *  [illegible] *   1.88  *   1.46
   ITEMS / SERVICE              B) NO RET       =  5.93  *  3.[illegible] *   4.82  *   4.68
6) AVERAGE NUMBER OF DWELLINGS / SERVICE        =  1.06  *   1.01  *   1.00  *   1.00
7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)      =149.73  *128.59  *247.96  *165.24
8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME       =  0.89  *   0.93  *   0.91  *   0.94
9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME    =  0.74  *   0.78  *   0.71  *   0.75
14) DUPLICATION OF HANDLING                     =  8.30% *   4.46% *  13.15% *   6.64%
15) A) TOTAL CREW TIME / DWELLING               =  1.13  *   1.11  *   1.10  *   1.07
    B) HANDLING TIME / DWELLING                 =  0.75  *   0.80  *   0.71  *   0.76
    C) PRODUCTIVE TIME / DWELLING               =  1.00  *   1.03  *   1.00  *   1.01
    D) CANS / DWELLING                          =  1.26  *   1.33  *   1.81  *   1.38
    E) SMALL CANS / DWELLING                    =  0.09  *   0.10  *   0.07  *   0.08
    F) BAGS / DWELLING                          =  4.44  *   2.75  *   4.14  *   3.63
    G) MISCELLANEOUS / DWELLING                 =  1.20  *   0.80  *   0.66  *   1.04
    H) RETURNABLES / DWELLING                   =  1.35  *   1.43  *   1.88  *   1.46
    I) NON-RETURNABLES / DWELLING               =  5.62  *   3.55  *   4.80  *   4.67
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      WARWICK, RHODE ISLAND    SYSTEM NUMBER 7  ROUTE(7/1-4)  4TH QUARTER  8/14/73


                                                         SYSTEM PERFORMANCE
                                                 ******************************************
                                                            BY QUARTER                CUMU-
           *ALL TIMES ARE IN MINUTES*                 1ST       2ND       3RD       4TH    LATIVE
                                                 ******************************************
                                                            *         *         *         *

 1) TIME EFFICIENCY OF CREW WHILE COLLECTING   = 91.95% * 91.10% * 90.46% * 92.11% * 91.93%
    ON ROUTE                                            *         *         *         *

 2) UTILIZATION OF DRIVERS TIME  A) DRIVING    = 20.04% * 28.13% * 24.33% * 24.87% * 24.23%
                                 B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING    = 79.48% * 71.67% * 74.17% * 74.64% * 75.19%
                                 D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER      =  0.48% *  0.20% *  1.51% *  0.00% *  0.35%
                                 F) COLLECTION=  0.00% *  0.00% *  0.00% *  0.49% *  0.23%

 3) UTILIZATION OF COLLECTORS    A) RIDING     = 15.52% * 22.34% * 18.98% * 17.58% * 17.73%
    TIME                         B) WALKING    =  4.65% *  6.41% *  4.13% *  5.26% *  5.08%
                                 C) WAITING    =  1.16% *  2.22% *  1.05% *  0.27% *  0.81%
                                 D) COMPACTION=  6.57% *  6.34% *  7.85% *  7.19% *  6.85%
                                 E) OTHER      =  0.32% *  0.34% *  0.64% *  0.43% *  0.40%
                                 F) COLLECTION= 71.77% * 62.35% * 67.35% * 69.27% * 69.13%

 4) AVERAGE NUMBER OF ITEMS      A) CANS       =  1.52  *  1.54  *  1.47  *  1.30  *  1.41
    BY TYPE / SERVICE            B) SMALL CANS=  0.09  *  0.06  *  0.07  *  0.11  *  0.09
                                 C) BAGS       =  6.47  *  1.96  *  2.59  *  3.25  *  3.59
                                 D) MISC.      =  1.03  *  0.74  *  0.76  *  1.17  *  1.00

 5) RETURNABLE / NON-RETURNABLE  A) RETURN     =  1.62  *  1.61  *  1.54  *  1.41  *  1.50
    ITEMS / SERVICE              B) NO RET     =  7.50  *  2.69  *  3.34  *  4.42  *  4.57

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE      =  1.01  *  1.00  *  1.00  *  1.05  *  1.03

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)    = 184.87 * 163.86 * 168.36 * 162.67 * 173.63

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME     =  0.92  *  0.91  *  0.90  *  0.92  *  0.92

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME =  0.78  *  0.68  *  0.74  *  0.75  *  0.75

14) DUPLICATION OF HANDLING                    = 11.04% *  7.99% *  7.29% *  3.60% *  7.38%

15) A) TOTAL CREW TIME / DWELLING              =  1.36  *  0.82  *  0.99  *  1.17  *  1.15
    B) HANDLING TIME / DWELLING                =  0.98  *  0.51  *  0.67  *  0.81  *  0.79
    C) PRODUCTIVE TIME / DWELLING              =  1.25  *  0.75  *  0.90  *  1.08  *  1.06
    D) CANS / DWELLING                         =  1.51  *  1.54  *  1.46  *  1.24  *  1.37
    E) SMALL CANS / DWELLING                   =  0.09  *  0.06  *  0.07  *  0.11  *  0.09
    F) BAGS / DWELLING                         =  6.40  *  1.95  *  2.58  *  3.09  *  3.49
    G) MISCELLANEOUS / DWELLING                =  1.02  *  0.74  *  0.76  *  1.11  *  0.98
    H) RETURNABLES / DWELLING                  =  1.60  *  1.60  *  1.53  *  1.34  *  1.46
    I) NON-RETURNABLES / DWELLING              =  7.42  *  2.68  *  3.33  *  4.21  *  4.45
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OAK PARK, ILLINOIS SYSTEM NUMBER 8 ROUTE(8/1-4) 4TH QUARTER 5/07/73-8/10/73

TIME & MOTION DATA REDUCTION

QUARTER	ROUTE	NUMBER OF SERVICES	NUMBER OF DWELLINGS	NUMBER OF ITEMS BY TYPE				NUMBER OF RETURN-ABLE ITEMS	NUMBER OF NON RETURN-ABLE ITEMS	TOTAL ITEMS	ROUTE DISTANCE (MILES)
				CANS	SMALL CANS	BAGS	MISCEL-LANEOUS				
1	8-1	307.	309.	620.	63.	464.	387.	683.	851.	1534.	2.20
1	8-2	202.	202.	506.	28.	419.	429.	534.	848.	1382.	1.96
1	8-3	256.	256.	660.	35.	393.	689.	695.	1082.	1777.	3.10
1	8-4	248.	253.	678.	34.	480.	541.	712.	1021.	1733.	2.30
	SUM	1013.	1020.	2464.	160.	1756.	2046.	2624.	3802.	6426.	9.56
	AVERAGE	253.	255.	616.	40.	439.	511.	656.	950.	1606.	2.39
2	8-1	255.	255.	490.	15.	365.	304.	505.	669.	1174.	2.20
2	8-2	229.	229.	578.	12.	206.	212.	590.	418.	1008.	3.00
2	8-3	230.	230.	576.	10.	306.	236.	586.	542.	1128.	3.30
2	8-4	63.	64.	130.	4.	99.	43.	134.	142.	276.	0.60
	SUM	777.	798.	1774.	41.	976.	795.	1815.	1771.	3586.	9.10
	AVERAGE	194.	199.	443.	10.	244.	199.	454.	443.	896.	2.27
3	8-1	152.	152.	333.	48.	228.	202.	381.	430.	811.	1.30
3	8-2	176.	176.	533.	23.	234.	272.	556.	506.	1062.	1.54
3	8-3	140.	140.	422.	24.	171.	240.	446.	411.	857.	1.30
3	8-4	61.	61.	180.	9.	99.	98.	189.	197.	386.	0.56
	SUM	529.	529.	1468.	104.	732.	812.	1572.	1544.	3116.	4.70
	AVERAGE	132.	132.	367.	26.	183.	203.	393.	386.	779.	1.17
4	8-1	293.	294.	668.	65.	446.	389.	733.	835.	1568.	2.50
4	8-2	197.	202.	592.	38.	189.	363.	630.	552.	1182.	2.10
4	8-3	192.	192.	579.	32.	292.	546.	611.	838.	1449.	2.70
4	8-4	135.	141.	430.	43.	182.	267.	473.	449.	922.	1.20
	SUM	817.	829.	2269.	178.	1109.	1565.	2447.	2674.	5121.	8.50
	AVERAGE	204.	207.	567.	44.	277.	391.	612.	668.	1280.	2.12
CUMULATIVE SUM		3136.	3176.	7975.	483.	4573.	5218.	8458.	9791.	18249.	31.86
CUMULATIVE AVERAGE		196.	198.	498.	30.	286.	326.	529.	612.	1141.	1.99

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       OAK PARK, ILLINOIS   SYSTEM NUMBER 8  ROUTE(8/1-4) 4TH QUARTER 8/07/73-8/10/73

                                  TIME & MOTION DATA REDUCTION

*********************************************************************************************************************
*          *          *               DRIVERS                     *                COLLECTORS TIME                  *
*          *          *                 TIME                      *                   (MINUTES)                     *
*          *          *              (MINUTES)                    ***************************************************
* QUARTER  *  ROUTE   ******************************************** TOTAL *          *          *          *          *
*          *          * DRIVING * WAITING * COLLECT * OTHER  * TIME  * RIDING * WALKING * WAITING * COMPACT * OTHER *
*********************************************************************************************************************
    1         8-1       16.51    170.00      0.45     1.89   381.73    0.57     35.59      3.28      4.68      0.50
    1         8-2       23.40    134.97     33.66     1.59   387.43    0.21     43.93      2.14      5.71      0.35
    1         8-3       28.25    162.35     15.75     2.14   416.99    3.91     39.13      5.97      5.08      0.64
    1         8-4       26.07    170.62      0.00     4.17   401.96    4.19     46.52      5.07     10.18      3.50
          SUM           96.22    637.95     49.85     9.79  1568.11    8.88    165.18     16.46     25.66      4.98
        AVERAGE         24.06    159.49     12.46     2.45   397.03    2.22     41.29      4.11      6.41      1.25


    2         8-1       16.80     75.84     39.90     0.59   266.29    2.19     42.15      2.04      9.37      1.86
    2         8-2       29.41    115.64      1.79     1.67   297.70    1.13     62.22      4.40      3.38      2.69
    2         8-3       30.63    137.06      0.00     0.35   336.68    2.19     66.59      6.75     11.20      1.76
    2         8-4        6.95     34.24      0.93     0.00    84.35    1.13     14.61      0.86      0.79      0.00
          SUM           83.79    362.78     42.63     2.61   985.02    6.64    185.57     14.06     24.74      6.32
        AVERAGE         20.95     90.70     10.66     0.65   246.26    1.66     46.39      3.52      6.19      1.58


    3         8-1       13.85     69.71     25.11     1.34   220.46    0.53     27.03      0.45      1.58      0.73
    3         8-2       24.12    117.87     17.74     1.18   322.45    0.00     40.67      0.00      2.31      0.57
    3         8-3       15.89     49.72     25.33     0.74   183.71    0.31     27.65      0.00      2.50      1.00
    3         8-4        6.80     35.52      0.00     0.00    84.77    0.00     10.45      0.12      1.71      0.00
          SUM           60.66    272.82     68.18     3.25   811.38    0.83    105.80      0.58      8.10      2.30
        AVERAGE         15.16     68.21     17.05     0.81   202.85    0.21     26.45      0.14      2.02      0.57


    4         8-1       23.64    110.49     54.39     0.61   379.02    5.38     39.48      3.16     11.10      1.25
    4         8-2       29.64    126.44     14.46     0.99   343.50    0.00     39.49      0.92      4.53      1.78
    4         8-3       33.50    137.38      1.76     1.50   348.75    2.10     44.85      0.34      9.79      3.20
    4         8-4       12.52    104.74      4.71     0.00   244.25    0.00     23.86      0.98     10.95      2.82
          SUM           99.31    479.05     75.32     3.10  1315.53    7.48    147.68      5.40     36.37      9.06
        AVERAGE         24.83    119.76     18.83     0.77   328.88    1.87     36.92      1.35      9.09      2.27

CUMULATIVE SUM         339.98   1752.61    235.98    18.76  4700.04   23.84    604.24     36.50     94.87     22.67
CUMULATIVE AVERAGE      21.25    109.54     14.75     1.17   293.75    1.49     37.76      2.28      5.93      1.42
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OAK PARK, ILLINOIS   SYSTEM NUMBER 8  ROUTE(8/1-4) 4TH QUARTER 8/07/73-8/10/73

                        TIME & MOTION DATA REDUCTION

************************************************************************************************
*          *          *                  *                  *             *              *              *
*          *          * TOTAL HANDLING   * RATIO OF         *    TOTAL    * RATIO OF     *              *
*          *          *      TIME        * HANDLING TIME    * PRODUCTIVE  * PRODUCTIVE   * TOTAL ITEMS  *
* QUARTER  *  ROUTE   *   (MINUTES)      * TO TOTAL TIME    *    TIME     * TIME TO      * HANDLED BY   *
*          *          *                  *                  *  (MINUTES)  * TOTAL TIME   * COLLECTORS   *
************************************************************************************************
    1         8-1          337.11                               373.27                        1940.
    1         8-2          335.09                               379.23                        1624.
    1         8-3          362.25                               405.30                        2021.
    1         8-4          332.50                               383.21                        1899.
              SUM         1366.95                              1541.01                        7484.
            AVERAGE        341.74                               385.25                        1871.


    2         8-1          208.67                               253.01                        1268.
    2         8-2          223.87                               287.22                        1176.
    2         8-3          248.19                               316.96                        1234.
    2         8-4           66.95                                82.69                         343.
              SUM          747.68                               939.90                        4021.
            AVERAGE        186.92                               234.97                        1005.


    3         8-1          190.14                               217.70                         814.
    3         8-2          278.90                               319.57                        1190.
    3         8-3          152.25                               180.21                         941.
    3         8-4           72.48                                82.93                         469.
              SUM          693.77                               800.41                        3414.
            AVERAGE        173.44                               200.10                         853.


    4         8-1          318.64                               363.50                        1485.
    4         8-2          296.78                               336.27                        1262.
    4         8-3          288.47                               335.42                        1572.
    4         8-4          205.64                               229.50                         983.
              SUM         1109.53                              1264.69                        5302.
            AVERAGE        277.38                               316.17                        1325.

  CUMULATIVE SUM          3917.93                              4546.00                       20221.
  CUMULATIVE AVERAGE       244.87                               284.13                        1264.
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          OAK PARK, ILLINOIS  SYSTEM NUMBER 8  ROUTE(8/1-4)   11/14/72-07/10/73


                                                                  ROUTE CUMULATIVES
                                                      ***********************************
              *ALL TIMES ARE IN MINUTES*                  8-1      8-2      8-3      8-4
                                                      ***********************************
                                                               *        *        *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING          * 96.79% * 97.87% * 96.25% * 95.46%
    ON ROUTE
 2) UTILIZATION OF DRIVERS TIME   A) DRIVING    * 11.68% * 15.80% * 16.86% * 12.85%
                                  B) WALKING    *  0.00% *  0.00% *  0.00% *  0.00%
                                  C) WAITING    * 68.37% * 73.37% * 75.74% * 84.74%
                                  D) COMPACTION*  0.00% *  0.00% *  0.00% *  0.00%
                                  E) OTHER      *  0.71% *  0.80% *  0.74% *  1.02%
                                  F) COLLECTION* 19.23% * 10.03% *  6.67% *  1.39%
 3) UTILIZATION OF COLLECTORS     A) RIDING     *  0.70% *  0.10% *  0.66% *  0.65%
    TIME                          B) WALKING    * 11.56% * 13.79% * 13.86% * 11.71%
                                  C) WAITING    *  0.72% *  0.55% *  1.02% *  0.86%
                                  D) COMPACTION*  2.14% *  1.18% *  2.22% *  2.90%
                                  E) OTHER      *  0.35% *  0.40% *  0.51% *  0.78%
                                  F) COLLECTION* 84.53% * 83.98% * 81.73% * 83.10%
 4) AVERAGE NUMBER OF ITEMS       A) CANS       *  2.10  *  2.75  *  2.73  *  2.80
    BY TYPE / SERVICE             B) SMALL CANS*  0.19  *  0.13  *  0.12  *  0.18
                                  C) BAGS       *  1.49  *  1.30  *  1.42  *  1.70
                                  D) MISC.      *  1.27  *  1.59  *  2.09  *  1.87
 5) RETURNABLE / NON-RETURNABLE   A) RETURN     *  2.29  *  2.87  *  2.86  *  2.97
    ITEMS / SERVICE               B) NO RET     *  2.77  *  2.89  *  3.51  *  3.57
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE       *  1.00  *  1.01  *  1.00  *  1.06
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)     * 42.87  * 56.13  * 67.13  * 45.65
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME      *  0.97  *  0.[illegible]  *  0.96  *  0.95
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME *  0.87  *  0.[illegible]  *  0.65  *  0.87
14) DUPLICATION OF HANDLING                     *  8.26% * 13.34% * 10.69% * 11.37%
15) A) TOTAL CREW TIME / DWELLING               *  1.24  *  1.67  *  1.57  *  1.51
    B) HANDLING TIME / DWELLING                 *  1.04  *  1.40  *  1.29  *  1.26
    C) PRODUCTIVE TIME / DWELLING               *  1.20  *  1.63  *  1.51  *  1.44
    D) CANS / DWELLING                          *  2.09  *  2.73  *  2.73  *  2.63
    E) SMALL CANS / DWELLING                    *  0.19  *  0.12  *  0.12  *  0.17
    F) BAGS / DWELLING                          *  1.49  *  1.30  *  1.42  *  1.60
    G) MISCELLANEOUS / DWELLING                 *  1.27  *  1.58  *  2.09  *  1.76
    H) RETURNABLES / DWELLING                   *  2.28  *  2.86  *  2.86  *  2.80
    I) NON-RETURNABLES / DWELLING               *  2.76  *  2.87  *  3.51  *  3.36
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OAK PARK, ILLINOIS   SYSTEM NUMBER 8  ROUTE(8/1-4) 4TH QUARTER 8/07/73-8/10/73

                                                            SYSTEM PERFORMANCE
                                                  *******************************************
                                                               BY QUARTER                 CUMU-
        *ALL TIMES ARE IN MINUTES*                    1ST     '2ND      3RD       4TH     LATIVE
                                                  *******************************************
                                                          *        *        *        *

1) TIME EFFICIENCY OF CREW WHILE COLLECTING    = 97.03% * 95.42% * 98.65% * 96.14% * 96.72%
   ON ROUTE                                               *        *        *        *

2) UTILIZATION OF DRIVERS TIME  A) DRIVING    = 12.12% * 17.04% * 14.98% * 15.12% * 14.46%
                                B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                C) WAITING    = 80.36% * 73.76% * 67.38% * 72.95% * 74.06%
                                D) COMPACTION=   0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                E) OTHER      =  1.23% *  0.53% *  0.80% *  0.47% *  0.80%
                                F) COLLECTION=   6.28% *  8.67% * 16.84% * 11.47% * 10.65%

3) UTILIZATION OF COLLECTORS    A) RIDING     =  0.56% *  0.67% *  0.10% *  0.57% *  0.51%
   TIME                         B) WALKING    = 10.40% * 18.84% * 13.04% * 11.23% * 12.86%
                                C) WAITING    =  1.04% *  1.43% *  0.07% *  0.41% *  0.78%
                                D) COMPACTION=   1.62% *  2.51% *  1.00% *  2.76% *  2.02%
                                E) OTHER      =  0.31% *  0.64% *  0.28% *  0.69% *  0.48%
                                F) COLLECTION= 86.07% * 75.90% * 85.50% * 84.34% * 83.36%

4) AVERAGE NUMBER OF ITEMS      A) CANS       =  2.43  *  2.28  *  2.78  *  2.78  *  2.54
   BY TYPE / SERVICE            B) SMALL CANS=   0.16  *  0.05  *  0.20  *  0.22  *  0.15
                                C) BAGS       =  1.73  *  1.26  *  1.38  *  1.36  *  1.46
                                D) MISC.      =  2.02  *  1.02  *  1.53  *  1.92  *  1.66

5) RETURNABLE / NON-RETURNABLE  A) RETURN     =  2.59  *  2.34  *  2.97  *  3.00  *  2.70
   ITEMS / SERVICE              B) NO RET     =  3.75  *  2.28  *  2.92  *  3.27  *  3.12

6) AVERAGE NUMBER OF DWELLINGS / SERVICE      =  1.01  *  1.03  *  1.00  *  1.01  *  1.01

7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)    = 49.49  * 60.21  * 46.91  * 54.14  * 52.97

8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME     =  0.97  *  0.95  *  0.99  *  0.96  *  0.97

9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME  =  0.89  *  0.80  *  0.87  *  0.86  *  0.86

14) DUPLICATION OF HANDLING
                                              = 16.46% * 12.13% *  9.56% *  3.53% * 10.81%

15) A) TOTAL CREW TIME / DWELLING
    B) HANDLING TIME / DWELLING               =  1.56  *  1.23  *  1.53  *  1.59  *  1.48
    C) PRODUCTIVE TIME / DWELLING             =  1.34  *  0.94  *  1.31  *  1.34  *  1.23
    D) CANS / DWELLING                        =  1.51  *  1.18  *  1.51  *  1.53  *  1.43
    E) SMALL CANS / DWELLING                  =  2.42  *  2.22  *  2.78  *  2.74  *  2.51
    F) BAGS / DWELLING                        =  0.16  *  0.05  *  0.20  *  0.21  *  0.15
    G) MISCELLANEOUS / DWELLING               =  1.72  *  1.22  *  1.38  *  1.34  *  1.44
    H) RETURNABLES / DWELLING                 =  2.01  *  1.00  *  1.53  *  1.09  *  1.64
    I) NON-RETURNABLES / DWELLING             =  2.57  *  2.27  *  2.97  *  2.95  *  2.66
                                              =  3.73  *  2.22  *  2.92  *  3.23  *  3.08
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          METRO DADE          SYSTEM NUMBER 9   ROUTE(9/1-4)  4TH QUARTER 4/9-13/73


                                   TIME & MOTION DATA REDUCTION

*****************************************************************************************************************
*           *           *           *           *                                *          *          *          *             *
*           *           *           *           *              NUMBER            *          *          *          *             *
*           *           *           *           *             OF ITEMS           * NUMBER   * NUMBER   *          *             *
*           *           *           *           *              BY TYPE           *   OF     * OF NON   *          *   ROUTE     *
*           *           * NUMBER    * NUMBER    ********************************** RETURN-* RETURN-*          * DISTANCE    *
*           *           *   OF      *   OF      *        * SMALL *        * MISCEL- * ABLE     * ABLE     * TOTAL    *************
* QUARTER   * ROUTE     * SERVICES  * DWELLINGS * CANS   * CANS  * BAGS   * LANEOUS * ITEMS    * ITEMS    * ITEMS    * (MILES)     *
*****************************************************************************************************************
     1         9-1          352.        354.     412.     25.     388.      165.      437.       553.       990.        9.70
     1         9-2          327.        330.     396.     19.     395.      194.      415.       589.      1004.       10.00
     1         9-3          309.        335.     264.     18.     369.      104.      302.       473.       775.       10.80
     1         9-4          294.        308.     305.     31.     377.       75.      336.       452.       788.        7.60
        SUM                1282.       1327.    1397.     93.    1529.      538.     1490.      2067.      3557.       38.10
       AVERAGE              320.        332.     349.     23.     382.      134.      372.       517.       889.        9.52


     2         9-1          394.        408.     524.     22.     470.      145.      546.       615.      1161.        8.90
     2         9-2          421.        423.     518.     41.     575.      209.      559.       784.      1343.       14.10
     2         9-3          363.        429.     302.     24.     423.       77.      326.       500.       826.       11.90
     2         9-4          342.        350.     325.     28.     332.       74.      353.       406.       759.       10.60
        SUM                1520.       1610.    1669.    115.    1800.      505.     1784.      2305.      4089.       45.50
       AVERAGE              380.        402.     417.     29.     450.      126.      446.       576.      1022.        1.37


     3         9-1          439.        477.     526.     15.     535.      148.      541.       683.      1224.       11.80
     3         9-2          465.        467.     512.     26.     637.      219.      538.       856.      1394.       13.90
     3         9-3          360.        467.     293.     14.     474.       99.      307.       573.       880.       11.50
     3         9-4          378.        378.     285.     16.     399.       79.      301.       478.       779.        9.80
        SUM                1642.       1789.    1616.     71.    2045.      545.     1687.      2590.      4277.       47.00
       AVERAGE              410.        447.     404.     18.     511.      136.      422.       647.      1069.        1.75


     4         9-1          431.        450.     549.     17.     546.      193.      566.       739.      1305.        9.30
     4         9-2          386.        387.     428.     27.     540.      175.      455.       715.      1170.        8.20
     4         9-3          245.        325.     191.      4.     344.       48.      195.       392.       587.        6.70
     4         9-4          295.        295.     230.     15.     301.       75.      245.       376.       621.        6.10
        SUM                1357.       1457.    1398.     63.    1731.      491.     1461.      2222.      3683.       30.30
       AVERAGE              339.        364.     349.     16.     433.      123.      365.       555.       921.        7.57


CUMULATIVE SUM             7158.       7640.    7478.    405.    8836.     2570.     7883.     11406.     19289.      191.20


CUMULATIVE AVERAGE          447.        477.     467.     25.     552.      161.      493.       713.      1206.        1.95
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                    METRO DADE          SYSTEM NUMBER 9   ROUTE(9/1-4)  4TH QUARTER 4/9-13/73


                                                  TIME & MOTION DATA REDUCTION

***********************************************************************************************************************
*           *           *                                      *                                                    *
*           *           *             DRIVERS                  *                 COLLECTORS TIME                    *
*           *           *               TIME                   *                    (MINUTES)                       *
*           *           *            (MINUTES)                 *****************************************************
*           *           ***************************************** TOTAL  *          *          *          *          
*  QUARTER  *   ROUTE   * DRIVING * WAITING * COLLECT * OTHER * TIME   * RIDING * WALKING * WAITING * COMPACT * OTHER *
***********************************************************************************************************************
      1         9-1        41.82    123.02      0.00     0.79  331.36    62.65    12.33      11.42      14.47      4.17
      1         9-2        34.28     78.99     15.77     0.00  258.14    63.73     5.60       4.23       9.56      3.09
      1         9-3        37.45     66.48      0.86     0.00  208.89    53.32    23.49       1.46       6.32      3.47
      1         9-4        28.79     77.76      0.85     0.00  214.57    41.08    14.63       4.01      10.03      3.26
          SUM             142.34    346.25     17.48     0.79 1012.96   220.78    56.05      21.14      40.38     13.99
        AVERAGE            35.59     86.56      4.37     0.20  253.24    55.20    14.01       5.28      10.09      3.50



      2         9-1        46.78    132.49      0.00     2.83  363.89    65.72    34.11       8.33      19.72      3.32
      2         9-2        43.97     75.33     19.19     0.58  277.11    79.93     8.95       1.30       6.57      2.13
      2         9-3        37.07     53.08      0.00     0.00  160.63    51.41    12.68       1.08       2.48      0.40
      2         9-4        39.07     60.77      0.91     0.00  201.30    78.41     8.30       3.06       4.08      0.15
          SUM             166.89    321.67     20.09     3.41 1022.93   275.47    64.04      13.78      32.85      5.99
        AVERAGE            41.72     80.42      5.02     0.85  255.73    68.87    16.01       3.45       8.21      1.50



      3         9-1        50.80    131.66      0.00     2.03  368.89    56.51    53.37       6.76      15.46      2.89
      3         9-2        45.27     67.75     15.95     0.00  257.25    79.43     7.93       1.07       4.96      0.00
      3         9-3        37.16     57.86      0.00     0.00  189.96    48.84    20.50       1.33       2.16      0.43
      3         9-4        36.09     66.13      2.67     0.00  209.76    58.17    17.34       7.79       9.28      0.90
          SUM             169.31    323.41     18.62     2.03 1025.86   242.95    99.14      16.95      31.86      4.22
        AVERAGE            42.33     80.85      4.65     0.51  256.47    60.74    24.76       4.24       7.96      1.05



      4         9-1        46.63    142.13      0.00     0.00  378.21    45.13    61.79       3.06      24.49      4.95
      4         9-2        35.92     61.88     12.04     0.80  221.31    57.74     7.00       1.21       3.07      1.17
      4         9-3        25.01     34.43      0.30     0.40  120.49    32.31    15.39       1.08       1.36      0.27
      4         9-4        25.51     53.99      2.97     0.42  166.05    36.35    18.57       7.87       3.28      5.00
          SUM             133.07    292.43     15.31     1.62  886.05   171.53   102.76      13.22      32.20     11.39
        AVERAGE            33.27     73.11      3.83     0.40  221.51    42.88    25.69       3.31       8.05      2.85

  CUMULATIVE SUM          744.70   1576.20     86.81     9.48 4833.86  1082.26   424.74      78.32     169.48     46.99
  CUMULATIVE AVERAGE       46.54     98.51      5.43     0.59  302.12    67.64    26.55       4.90      10.59      2.94
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         METRO DADE          SYSTEM NUMBER 9   ROUTE(9/1-4)  4TH QUARTER 4/9-13/73


                                        TIME & MOTION DATA REDUCTION

*********************************************************************************************************
*            *            *                  *                  *              *              *              *
*            *            *                  *                  *    TOTAL     * RATIO OF     *              *
*            *            * TOTAL HANDLING   * RATIO OF         * PRODUCTIVE   * PRODUCTIVE   * TOTAL ITEMS  *
*            *            *      TIME        * HANDLING TIME    *    TIME      * TIME TO      * HANDLED BY   *
*  QUARTER   *   ROUTE    *   (MINUTES)      * TO TOTAL TIME    *  (MINUTES)   * TOTAL TIME   * COLLECTORS   *
*********************************************************************************************************
     1          9-1          226.32                               301.30                           1055.
     1          9-2          171.93                               241.27                           1054.
     1          9-3          120.81                               197.62                            818.
     1          9-4          141.55                               197.27                            998.
                SUM          660.62                               937.45                           3925.
              AVERAGE        165.16                               234.36                            981.



     2          9-1          232.70                               332.52                           1245.
     2          9-2          178.22                               267.10                           1380.
     2          9-3          112.58                               176.67                            875.
     2          9-4          107.29                               194.01                            875.
                SUM          630.79                               970.30                           4375.
              AVERAGE        157.70                               242.58                           1094.



     3          9-1          233.90                               343.77                           1321.
     3          9-2          163.86                               251.22                           1402.
     3          9-3          116.70                               186.04                            957.
     3          9-4          116.28                               191.79                            895.
                SUM          630.74                               972.83                           4575.
              AVERAGE        157.68                               243.21                           1144.



     4          9-1          238.79                               345.71                           1402.
     4          9-2          151.12                               215.86                           1172.
     4          9-3           70.07                               117.77                            611.
     4          9-4           94.97                               149.89                            673.
                SUM          554.96                               829.24                           3858.
              AVERAGE        138.74                               207.31                            964.

  CUMULATIVE SUM            3032.06                              4539.06                          20591.
  CUMULATIVE AVERAGE         189.50                               283.69                           1287.
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     METRO DADE          SYSTEM NUMBER 9   ROUTE(9/1-4)  4TH QUARTER 4/9-13/73


                                                          ROUTE CUMULATIVES
                                                  **********************************

          *ALL TIMES ARE IN MINUTES*                   9-1      9-2      9-3      9-4
                                                  **********************************
                                                          *        *        *

 1) TIME EFFICIENCY OF CREW WHILE COLLECTING   = 91.75% * 96.22% * 96.88% * 92.58%
    ON ROUTE                                              *        *        *
 2) UTILIZATION OF DRIVERS TIME  A) DRIVING    = 25.80% * 31.40% * 39.04% * 32.70%
                                 B) WALKING    =  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING    = 73.41% * 55.93% * 60.51% * 65.33%
                                 D) COMPACTION=  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER      =  0.79% *  0.27% *  0.11% *  0.11%
                                 F) COLLECTION=  0.00% * 12.40% *  0.33% *  1.87%
 3) UTILIZATION OF COLLECTORS    A) RIDING     = 15.95% * 27.70% * 26.56% * 27.03%
    TIME                         B) WALKING    = 11.20% *  2.91% * 10.29% *  7.43%
                                 C) WAITING    =  2.05% *  0.77% *  0.71% *  2.87%
                                 D) COMPACTION=  5.14% *  2.38% *  1.76% *  3.37%
                                 E) OTHER      =  1.06% *  0.63% *  0.65% *  1.18%
                                 F) COLLECTION= 64.60% * 65.61% * 60.03% * 58.12%
 4) AVERAGE NUMBER OF ITEMS      A) CANS       =  1.24  *  1.16  *  0.84  *  0.87
    BY TYPE / SERVICE            B) SMALL CANS=  0.05  *  0.07  *  0.05  *  0.07
                                 C) BAGS       =  1.20  *  1.34  *  1.26  *  1.08
                                 D) MISC.      =  0.40  *  0.50  *  0.26  *  0.23
 5) RETURNABLE / NON-RETURNABLE  A) RETURN     =  1.29  *  1.23  *  0.88  *  0.94
    ITEMS / SERVICE              B) NO RET     =  1.60  *  1.84  *  1.52  *  1.31
 6) AVERAGE NUMBER OF DWELLINGS / SERVICE      =  1.05  *  1.01  *  1.22  *  1.02
 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)   =124.11  *151.80  *138.79  *135.27
 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME     =  0.92  *  0.96  *  0.97  *  0.93
 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME =  0.70  *  0.68  *  0.62  *  0.63
14) DUPLICATION OF HANDLING                    =  7.33% *  1.98% *  6.29% * 16.76%
15) A) TOTAL CREW TIME / DWELLING              =  0.85  *  0.63  *  0.45  *  0.59
    B) HANDLING TIME / DWELLING                =  0.55  *  0.41  *  0.27  *  0.35
    C) PRODUCTIVE TIME / DWELLING              =  0.78  *  0.61  *  0.44  *  0.55
    D) CANS / DWELLING                         =  1.19  *  1.15  *  0.69  *  0.86
    E) SMALL CANS / DWELLING                   =  0.05  *  0.07  *  0.04  *  0.07
    F) BAGS / DWELLING                         =  1.15  *  1.34  *  1.03  *  1.06
    G) MISCELLANEOUS / DWELLING                =  0.39  *  0.50  *  0.21  *  0.23
    H) RETURNABLES / DWELLING                  =  1.24  *  1.22  *  0.73  *  0.93
    I) NON-RETURNABLES / DWELLING              =  1.53  *  1.83  *  1.25  *  1.29
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        METRO DADE          SYSTEM NUMBER 9   ROUTE(9/1-4)  4TH QUARTER 4/9-13/73

                                                            SYSTEM PERFORMANCE
                                                  ************************************************
                                                                BY QUARTER                 CUMU-
              *ALL TIMES ARE IN MINUTES*                1ST       2ND       3RD       4TH     LATIVE
                                                  ************************************************
                                                          *         *         *         *
 1) TIME EFFICIENCY OF CREW WHILE COLLECTING      = 92.55% * 94.86% * 94.84% * 93.59% * 93.90%
    ON ROUTE                                              *         *         *         *

 2) UTILIZATION OF DRIVERS TIME  A) DRIVING     = 28.08% * 32.59% * 32.98% * 30.08% * 30.81%
                                 B) WALKING     =  0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 C) WAITING     = 68.31% * 62.82% * 63.00% * 66.10% * 65.21%
                                 D) COMPACTION=    0.00% *  0.00% *  0.00% *  0.00% *  0.00%
                                 E) OTHER       =  0.16% *  0.67% *  0.40% *  0.37% *  0.39%
                                 F) COLLECTION=    3.45% *  3.92% *  3.63% *  3.46% *  3.59%

 3) UTILIZATION OF COLLECTORS    A) RIDING      = 21.80% * 26.93% * 23.68% * 19.36% * 22.39%
    TIME                         B) WALKING     =  5.53% *  6.26% *  9.66% * 11.60% *  8.79%
                                 C) WAITING     =  2.09% *  1.35% *  1.65% *  1.49% *  1.62%
                                 D) COMPACTION=    3.99% *  3.21% *  3.11% *  3.63% *  3.51%
                                 E) OTHER       =  1.38% *  0.59% *  0.41% *  1.29% *  0.97%
                                 F) COLLECTION= 65.22% * 61.66% * 61.48% * 62.63% * 62.73%

 4) AVERAGE NUMBER OF ITEMS      A) CANS        =  1.09  *  1.10  *  0.98  *  1.03  *  1.04
    BY TYPE / SERVICE            B) SMALL CANS=    0.07  *  0.08  *  0.04  *  0.05  *  0.06
                                 C) BAGS        =  1.19  *  1.18  *  1.25  *  1.28  *  1.23
                                 D) MISC.       =  0.42  *  0.33  *  0.33  *  0.36  *  0.36

 5) RETURNABLE / NON-RETURNABLE  A) RETURN      =  1.16  *  1.17  *  1.03  *  1.08  *  1.10
    ITEMS / SERVICE              B) NO RET      =  1.61  *  1.52  *  1.58  *  1.64  *  1.59

 6) AVERAGE NUMBER OF DWELLINGS / SERVICE       =  1.04  *  1.06  *  1.09  *  1.07  *  1.07

 7) AVERAGE DISTANCE BETWEEN SERVICES (FT.)     = 151.60 * 149.22 * 138.71 * 109.80 * 132.14

 8) RATIO OF PRODUCTIVE TIME TO TOTAL TIME      =  0.93  *  0.95  *  0.95  *  0.94  *  0.94

 9) RATIO OF HANDLING TIME TO PRODUCTIVE TIME   =  0.70  *  0.65  *  0.65  *  0.67  *  0.67

14) DUPLICATION OF HANDLING
                                                = 10.35% *  6.99% *  6.97% *  4.75% *  6.75%

15) A) TOTAL CREW TIME / DWELLING
    B) HANDLING TIME / DWELLING                 =  0.76  *  0.64  *  0.57  *  0.61  *  0.63
    C) PRODUCTIVE TIME / DWELLING               =  0.50  *  0.39  *  0.35  *  0.38  *  0.40
    D) CANS / DWELLING                          =  0.71  *  0.60  *  0.54  *  0.57  *  0.59
    E) SMALL CANS / DWELLING                    =  1.05  *  1.04  *  0.90  *  0.96  *  0.98
    F) BAGS / DWELLING                          =  0.07  *  0.07  *  0.04  *  0.04  *  0.05
    G) MISCELLANEOUS / DWELLING                 =  1.15  *  1.12  *  1.14  *  1.19  *  1.16
    H) RETURNABLES / DWELLING                   =  0.41  *  0.31  *  0.30  *  0.34  *  0.34
    I) NON-RETURNABLES / DWELLING               =  1.12  *  1.11  *  0.94  *  1.00  *  1.03
                                                =  1.56  *  1.43  *  1.45  *  1.53  *  1.49
```

CUMULATIVE DATA

Route Number	Number of Services	Number of Dwellings	Number of Items				Number of Returnables	Number of Non-returnables	Total Items	Number of Homes per Item					
			Cans	Small Cans	Bags	Misc.				1	2	3	4	5	More Than Five (Number)
10-1	343	375	448	1	15	0	449	15	464	294	64	7	4	1	
10-2	355	355	409	1	4	9	410	13	423	300	51	4	1	1	
10-3	358	358	450	0	4	6	450	10	460	263	91	2	1	1	
10-4	349	376	438	2	7	13	440	20	460	309	61	2	3		1- (11 Items)
TOTAL	1405	1464	1745	4	30	28	1749	58	1807	1166	267	15	9	3	

D. Cumulative Data

Productive time per data point (YP) in the following table was calculated using all data gathered during the four quarterly storage location surveys.

Cumulative YP*

Route	Homes Surveyed	San Leandro Equation	General Backyard Equation
10-1	343	7.43	7.25
10-2	355	6.76	6.21
10-3	358	6.86	6.11
10-4	345	7.04	6.92
System	1405	7.01	6.61

*Productive time per data point (all data points consist of 5 services)

Productive Time Per Man Per Service

Route	San Leandro Equation	General Backyard Equation
10-1	.74	.73
10-2	.68	.62
10-3	.67	.61
10-4	.70	.69
System	.70	.66

YTD collection time per home per collection from the March, 1973 DAAS printout is 0.8 minutes.

Projected Efficiency*

Equation Used	Efficiency
San Leandro	87.5%
General Backyard	82.5%

*Storage location calculations (YP) vs. DAAP collection minutes.

CUMULATIVE DATA

Homes with more than 15 items are not included in this matrix

Route Number	Number of Services	Number of Dwellings	Number of Items				Number of Returnables	Number of Non-returnables	Total Items	Frequency of Homes with Number of Items Indicated														
			Cans	Small Cans	Bags	Misc.				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11-1	327	334	752	120	299	224	872	523	1395	25	69	72	60	27	24	18	7	7	5	2		1	1	
11-2	319	317	609	114	586	156	723	742	1465	30	55	49	47	43	24	18	23	8	4	2	5		2	
11-3	352	353	685	103	661	161	789	822	1611	20	46	77	72	32	25	9	8	9	6	4				2
11-4	274	274	548	77	261	138	627	399	1023	31	55	71	47	23	18	7	5	3	2	4	1	2		2
TOTAL	1272	1278	2594	414	1807	679	3011	2486	5494	106	225	265	226	125	91	52	43	27	17	12	6	3	3	4

?

Cumulative Data

Productive time per data point (Yp) was calculated using all data gathered during the four quarterly Storage Location Surveys.

Cumulative Yp*

Route	Homes Surveyed	Yp (General Backyard Equation)
11-1	377	9.07
11-2	319	9.23
11-3	352	8.79
11-4	274	8.41
System	1272	8.88

*Productive time per data point (all data points consist of 5 services)

Productive Time Per Man Per Service

Route	General Backyard Equation
11-1	.91
11-2	.92
11-3	.88
11-4	.84
System	.89

YTD collection time per home per collection from the June, 1973 DAAS printout is 1.4 minutes.

Projected Efficiency*

General Backyard Equation	63.6%

*Storage location calculations (Yp) vs. DAAP collection minutes.

APPENDIX 4
DERIVATION OF COST FORMULAS

To compare local performance costs with the standard systems costs a set of formulas has been developed to use in translating systems studies costs to local costs. By using known costs of the local system and injecting these costs into a given formula, an agency can predict with some degree of accuracy its cost for achieving the systems study results.

Total costs used in the standard systems costs are broken down into two major categories: manpower costs and equipment costs. All other costs are derived from these two major costs. Manpower costs (per day) include labor costs, fringe benefits and personnel overhead. Equipment costs (per day) include depreciation, maintenance, daily consumables and other costs such as insurance and fees.

Depicting this mathematically, we have $TC = MC + EC$, where TC = total costs, MC = manpower cost and EC = equipment cost. Correlating local costs with this, we have $TC_l = MC_l + EC_l$, using subscript l to designate all local costs.

To convert systems study performance costs per home per week to local costs per home per week use $CPH_l = CPH \frac{TC_l}{TC}$. When seeking local performance cost per tons use $CPT_l = CPT \frac{TC_l}{TC}$.

Where $TC = MC + EC$, it follows that $TCC = MCC + ECC$. This formula is the basis for converting systems study performance collection costs to local collection costs. TCC = total collection cost, MCC = manpower collection costs and ECC = equipment collection costs. Again, subscript l will be used to designate local data.

If $MCC = MC \frac{TCC}{TC}$ and $ECC = EC \frac{TCC}{TC}$, then by substitution

$TCC = MC\frac{TCC}{TC} + EC\frac{TCC}{TC}$. Knowing there is a constant factor of collection time over total time ($K = \frac{\text{collection time}}{\text{total time}}$), involved in MCC and ECC, it can the be seen that $\frac{MCC_l}{MCC} = \frac{MC_l}{MC}$ and $\frac{ECC_l}{ECC} = \frac{EC_l}{EC}$. From these formulas $TCC_l = MC_l\frac{TCC}{TC}\frac{MC_l}{MC} + EC\frac{TCC}{TC}\frac{EC_l}{EC}$. This formula is used for varying labor costs and/or equipment costs.

If local collection times and total costs are known, then local collection costs can be found by $TCC_l = TC_l\frac{CT_l}{TT_l}$, where CT_l = local collection time and TT_l = local total time spent on the route.

To find local collection cost per home per day from systems study performance costs the formula $CCPH_l = \frac{TCC_l}{H}$ is used, where $CCPH_l$ = local collection cost per home and H = systems study number of homes. The collection cost per ton formula is similar to the one above in that $CCPT_l = \frac{TCC_l}{T}$, where $CCPT_l$ = local collection cost per ton, and T = the systems study weight collected in tons.

The following formula for converting systems study performance transport cost to local transport cost follows the same format as the collection cost formula. Remembering that TC = MC + EC, then XC = MXC + EXC, where XC = transport cost, MXC = manpower transport cost, and EXC = equipment transport cost. To find local transport cost use $XC_l = TC_l\frac{XT_l}{TT_l}$, where XT_l = the local systems total transport time, and TT_l = total time spent on the route. Since local transport cost is now known, this cost can be factored intc manpower transport cost and equipment transport cost by the formulas $MXC_l = MC_l\frac{XC_l}{TC_l}$, and $EXC_l = EC_l\frac{XC_l}{TC_l}$.

To find how cost per home served is affected by local transport costs use $XCPH_l = \frac{XC_l}{H}$, where $XCPH_l$ = local transport cost per home served and H = systems study number of homes. The same holds true for cost per tons in that $XCPT_l = \frac{XC_l}{T}$, where $XCPT_l$ = local transport cost per ton and T = amount of weight collected in tons from the systems study.

APPENDIX 5
EQUATION 1

```
SYSTEMS 1-9
COLL MINS PER HOME AS A FUNCTION OF % ONE-WAY ITEMS AND LBS PER HOME PER COLL

AVERAGES
VAR( 1)=        59.00, VAR( 2)=        47.76, VAR( 3)=          0.64

STANDARD DEVIATIONS
VAR( 1)=        17.35, VAR( 2)=        16.58, VAR( 3)=          0.25

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.279, VARS( 1, 3)=    -0.301
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.683

STEP NUMBER      1          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            0.196
STD. DEV. AS PERCENT OF RESPONSE MEAN=    30.805
PERCENT VARIATION EXPLAINED R-SQ=         46.680
CORRECTED R-SQ AS A PERCENT=              39.063
GOODNESS OF FIT OR OVERALL F,F(  1,  7)=   6.128
CONSTANT TERM=                        0.14185198

VAR        COEFF                STD DEV            T VALUE
                                 COEFF
  2        0.01033814           0.00417610         2.47554941

STEP NUMBER      2          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=            0.151
STD. DEV. AS PERCENT OF RESPONSE MEAN=    23.751
PERCENT VARIATION EXPLAINED R-SQ=         72.832
CORRECTED R-SQ AS A PERCENT=              63.777
GOODNESS OF FIT OR OVERALL F,F(  2,  6)=   8.043
CONSTANT TERM=                        0.48880096

VAR        COEFF                STD DEV            T VALUE
                                 COEFF
  1       -0.00764757           0.00320294        -2.40328147
  2        0.01258307           0.00335254         3.75329823

 OBS       ACTUAL     ESTIMATE     RESIDUAL       NORMAL
                                                  DEVIATE
   1        0.56        0.70        -0.14        -0.93
   2        1.06        1.02         0.06         0.39
   3        0.72        0.48         0.24         1.58
   4        0.56        0.55         0.01         0.03
   5        0.49        0.40         0.09         0.59
   6        0.44        0.50        -0.06        -0.37
   7        0.58        0.72        -0.14        -0.91
   8        0.98        0.90         0.08         0.55
   9        0.31        0.45        -0.14        -0.94
```

```
                                                   EQUATION 2
SYSTEMS 1-9  - COLLECTION MIAUTES PER HOME AS A FUNCTION OF % ONE-WAY ITEMS,
POUNDS PER HOME PER COLLECTION, AND HOMES PER COLLECTION MILE

AVERAGES
VAR( 1)=         59.00, VAR( 2)=         47.76, VAR( 3)=         46.89, VAR( 4)=          0.64

STANDARD DEVIATIONS
VAR( 1)=         17.35, VAR( 2)=         16.58, VAR( 3)=         17.71, VAR( 4)=          0.25

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=      1.000, VARS( 1, 2)=      0.279, VARS( 1, 3)=      0.181, VARS( 1, 4)=     -0.301
VARS( 2, 2)=      1.000, VARS( 2, 3)=      0.166, VARS( 2, 4)=      0.683
VARS( 3, 3)=      1.000, VARS( 3, 4)=     -0.087

STEP NUMBER      1           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=               0.196
STD. DEV. AS PERCENT OF RESPCNSE MEAN=        30.805
PERCENT VARIATION EXPLAINED R-SQ=             46.680
CORRECTED R-SC AS A PERCENT=                  39.063
GOODNESS OF FIT OR OVERALL F,F(  1,  7)=       6.128
CONSTANT TERM=                            0.14185198

VAR          COEFF                STD DEV              T VALUE
                                   COEFF
  2        0.01033814            0.CC417610           2.47554941

STEP NUMBER      2           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=               0.151
STD. DEV. AS PERCENT OF RESPCNSE MEAN=        23.751
PERCENT VARIATION EXPLAINED R-SQ=             74.832
CORRECTED R-SC AS A PERCENT=                  63.777
GOODNESS OF FIT OR OVERALL F,F(  2,  6)=       8.043
CONSTANT TERM=                            0.48860096

VAR          COEFF                STD DEV              T VALUE
                                   COEFF
  1       -0.00769757            0.CC32C294          -2.40328147
  2        0.01256307            0.00335254           3.75329823

STEP NUMBER      3           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=               0.160
STD. DEV. AS PERCENT OF RESPONSE MEAN=        25.174
PERCENT VARIATION EXPLAINED R-SQ=             74.565
CORRECTED R-SQ AS A PERCENT=                  59.303
GOODNESS OF FIT OR OVERALL F,F(  3,  5)=       4.886
CONSTANT TERM=                            0.54932185

VAR          COEFF                STD DEV              T VALUE
                                   COEFF
  1       -0.00741271            0.00342988          -2.16121694
  2        0.01283828            0.00358033           3.58577941
  3       -0.00190910            0.0C327171          -0.58351789
```

EQUATION 3

```
SYSTEMS 1-9  COLLECTION MINUTES PER HOME AS A FUNCTION OF PERCENT ONE-WAY ITEMS,
             POUNDS PER HOME PER COLLECTION, AND NUMBER OF ITEMS

AVERAGES
VAR( 1)=        59.00, VAR( 2)=        47.76, VAR( 3)=         4.43, VAR( 4)=         0.64

STANDARD DEVIATIONS
VAR( 1)=        17.35, VAR( 2)=        16.56, VAR( 3)=         1.38, VAR( 4)=         0.25

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=      0.279, VARS( 1, 3)=      0.518, VARS( 1, 4)=    -0.301
VARS( 2, 2)=     1.000, VARS( 2, 3)=      0.906, VARS( 2, 4)=      0.683
VARS( 3, 3)=     1.000, VARS( 3, 4)=      0.489

STEP NUMBER      1          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            0.196
STD. DEV. AS PERCENT OF RESPONSE MEAN=     30.805
PERCENT VARIATION EXPLAINED R-SQ=          46.680
CORRECTED R-SQ AS A PERCENT=               39.063
GOODNESS OF FIT OR OVERALL F,F(  1,  7)=    6.128
CONSTANT TERM=                          0.14165198

VAR        COEFF              STD DEV            T VALUE
                              COEFF
  2        0.01033814         0.00417610         2.47554941

STEP NUMBER      2          ENTER VARIABLE  1
.STANDARD DEVIATION OF RESIDUALS=           0.151
STD. DEV. AS PERCENT OF RESPONSE MEAN=     23.751
PERCENT VARIATION EXPLAINED R-SQ=          72.832
CORRECTED R-SQ AS A PERCENT=               63.777
GOODNESS OF FIT OR OVERALL F,F(  2,  6)=    8.043
CONSTANT TERM=                          0.48860096

VAR        COEFF              STD DEV            T VALUE
                              COEFF
  1       -0.00769757         0.00320294        -2.40328147
  2        0.01258307         0.00335254         3.75329823

STEP NUMBER      3          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            0.165
STD. DEV. AS PERCENT OF RESPONSE MEAN=     25.964
PERCENT VARIATION EXPLAINED R-SQ=          72.943
CORRECTED R-SQ AS A PERCENT=               56.709
GOODNESS OF FIT OR OVERALL F,F(  3,  5)=    4.493
CONSTANT TERM-                          0.49267028

VAR        COEFF              STD DEV            T VALUE
                              COEFF
  1       -0.00812942         0.00462273        -1.75857420
  2        0.01128464         0.00978688         1.15303718
  3        0.01881578         0.13150357         0.14308191
```

EQUATION 4

```
SYSTEMS 1-9  COLLECTION MINUTES PER HOME AS A FUNCTION OF PERCENT ONE-WAY ITEMS,
             POUNDS PER HOME PER COLLECTION, NUMBER OF ITEMS, AND CREW SIZE

AVERAGES
VAR( 1)=        59.00, VAR( 2)=        47.76, VAR( 3)=          4.43, VAR( 4)=         2.00,
VAR( 5)=         0.64

STANDARD DEVIATIONS
VAR( 1)=        17.35, VAR( 2)=        16.58, VAR( 3)=          1.38, VAR( 4)=         0.87,
VAR( 5)=         0.25

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.279, VARS( 1, 3)=     0.518, VARS( 1, 4)=     0.349,
VARS( 1, 5)=    -0.301
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.906, VARS( 2, 4)=     0.129, VARS( 2, 5)=     0.683
VARS( 3, 3)=     1.000, VARS( 3, 4)=     0.219, VARS( 3, 5)=     0.489
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.282

STEP NUMBER      1           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              0.196
STD. DEV. AS PERCENT OF RESPONSE MEAN=     30.605
PERCENT VARIATION EXPLAINED R-SQ=           46.680
CORRECTED R-SQ AS A PERCENT=                39.063
GOODNESS OF FIT OR OVERALL F,F(  1,  7)=    6.128
CONSTANT TERM=                          0.14165198

VAR         COEFF                STD DEV             T VALUE
                                  COEFF
  2        0.01033814           0.00417610          2.47554941

STEP NUMBER      2           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.151
STD. DEV. AS PERCENT OF RESPONSE MEAN=     23.751
PERCENT VARIATION EXPLAINED R-SQ=           72.832
CORRECTED R-SQ AS A PERCENT=                63.777
GOODNESS OF FIT OR OVERALL F,F(  2,  6)=    8.043
CONSTANT TERM=                          0.46880096

VAR         COEFF                STD DEV             T VALUE
                                  COEFF
  1       -0.00769757           0.00320294         -2.40328147
  2        0.01258307           0.00335254          3.75329823

STEP NUMBER      3           ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              0.150
STD. DEV. AS PERCENT OF RESPONSE MEAN=     23.658
PERCENT VARIATION EXPLAINED R-SQ=           77.537
CORRECTED R-SQ AS A PERCENT=                64.060
GOODNESS OF FIT OR OVERALL F,F(  3,  5)=    5.753
CONSTANT TERM=                          0.55009650

VAR         COEFF                STD DEV             T VALUE
                                  COEFF
  1       -0.00655938           0.00337870         -1.94138917
```

```
CURB-ALLEY ONCE A WEEK COLLECTION - COLL MINS PER SERVICE AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=       58.20, VAR( 2)=        2.01, VAR( 3)=       62.40, VAR( 4)=        8.92,
VAR( 5)=        0.73

STANDARD DEVIATIONS
VAR( 1)=       13.92, VAR( 2)=        0.85, VAR( 3)=       15.89, VAR( 4)=        3.09,
VAR( 5)=        0.25

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.116, VARS( 1. 3)=    -0.228, VARS( 1. 4)=    -0.394,
VARS( 1, 5)=     0.702
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.424, VARS( 2. 4)=    -0.112, VARS( 2. 5)=    -0.109
VARS( 3, 3)=     1.000, VARS( 3, 4)=     0.644, VARS( 3, 5)=    -0.608
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.750

STEP NUMBER      1           ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              0.162
STD. DEV. AS PERCENT OF RESPONSE MEAN=       22.344
PERCENT VARIATION EXPLAINED R-SQ=            56.278
CORRECTED R-SQ AS A PERCENT=                 56.121
GOODNESS OF FIT OR OVERALL F,F(  1,279)=    359.121
CONSTANT TERM=                           1.25744480

VAR        COEFF               STD DEV            T VALUE
                                COEFF
  4      -0.05950134          0.00313983      -18.95050140

STEP NUMBER      2           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.121
STD. DEV. AS PERCENT OF RESPONSE MEAN=       16.647
PERCENT VARIATION EXPLAINED R-SQ=            75.818
CORRECTED R-SQ AS A PERCENT=                 75.644
GOODNESS OF FIT OR OVERALL F,F(  2,278)=    435.801
CONSTANT TERM=                           0.63072682

VAR        COEFF               STD DEV            T VALUE
                                COEFF
  1       0.00846657          0.00056490       14.98764469
  4      -0.04448957          0.00254470      -17.48322230

STEP NUMBER      3           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              0.107
STD. DEV. AS PERCENT OF RESPONSE MEAN=       14.747
PERCENT VARIATION EXPLAINED R-SQ=            81.092
CORRECTED R-SQ AS A PERCENT=                 80.887
GOODNESS OF FIT OR OVERALL F,F(  3,277)=    396.003
CONSTANT TERM=                           0.75733297

VAR        COEFF               STD DEV            T VALUE
                                COEFF
  1       0.00881397          0.00050197       17.55875456
  2       -0.06649599          0.00756453        -8.79049804
  4       -0.04593683          0.00226019       -20.32429902

STEP NUMBER     4           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            0.107
STD. DEV. AS PERCENT OF RESPONSE MEAN=     14.716
PERCENT VARIATION EXPLAINED R-SQ=          81.238
CORRECTED R-SQ AS A PERCENT=               80.966
GOODNESS OF FIT OR OVERALL F,F(  4,276)= 298.767
CONSTANT TERM=                         0.77002181

VAR         COEFF               STD DEV              T VALUE
                                 COEFF
  1        0.00879921          0.00050104        17.56201006
  2       -0.05697864          0.00995962        -5.72096356
  3       -0.00101700          0.00069423        -1.46494052
  4       -0.04229852          0.00335494       -12.60783058
```

```
CURB-ALLEY TWICE A WEEK COLLECTION- COLL MINS PER SERVICE AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=         28.36, VAR( 2)=         2.02, VAR( 3)=        48.33, VAR( 4)=        14.89,
VAR( 5)=          0.49

STANDARD DEVIATIONS
VAR( 1)=          4.70, VAR( 2)=         0.82, VAR( 3)=         8.25, VAR( 4)=         4.44,
VAR( 5)=          0.17

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.457, VARS( 1, 3)=     0.773, VARS( 1, 4)=    -0.643,
VARS( 1, 5)=    -0.222
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.580, VARS( 2, 4)=    -0.292, VARS( 2, 5)=    -0.954
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.915, VARS( 3, 5)=    -0.418
VARS( 4, 4)=     1.000, VARS( 4, 5)=     0.154

STEP NUMBER      1            ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              0.052
STD. DEV. AS PERCENT OF RESPONSE MEAN=       10.760
PERCENT VARIATION EXPLAINED R-SQ=            90.975
CORRECTED R-SQ AS A PERCENT=                 90.916
GOODNESS OF FIT OR OVERALL F,F(  1,154)=1552.378
CONSTANT TERM=                           0.89483233

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  2      -0.20178450        0.00512140      -39.40024106

STEP NUMBER      2            ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.031
STD. DEV. AS PERCENT OF RESPONSE MEAN=        6.437
PERCENT VARIATION EXPLAINED R-SQ=            96.791
CORRECTED R-SQ AS A PERCENT=                 96.749
GOODNESS OF FIT OR OVERALL F,F(  2,153)=2307.493
CONSTANT TERM=                           0.66263217

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  1       0.01005531        0.00060383       16.65259081
  2      -0.22802657        0.00344531      -66.18471997

STEP NUMBER      3            ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              0.031
STD. DEV. AS PERCENT OF RESPONSE MEAN=        6.426
PERCENT VARIATION EXPLAINED R-SQ=            96.824
CORRECTED R-SQ AS A PERCENT=                 96.761
GOODNESS OF FIT OR OVERALL F,F(  3,152)=1544.384
CONSTANT TERM=                           0.63299762

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  1       0.01061738        0.00075300       14.10002682
  2       -0.22803870          0.00343913       -66.30701731
  4        0.00092124          0.00073976         1.24532964

STEP NUMBER     4          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=           0.031
STD. DEV. AS PERCENT OF RESPONSE MEAN=     6.331
PERCENT VARIATION EXPLAINED R-SQ=         96.937
CORRECTED R-SQ AS A PERCENT=              96.855
GOODNESS OF FIT OR OVERALL F,F(  4,151)=1194.521
CONSTANT TERM=                        0.44292588

VAR         COEFF               STD DEV             T VALUE
                                 COEFF
  1        0.00946934          0.00088713        10.67415172
  2       -0.23835427          0.00552989       -43.10291038
  3        0.00357804          0.00151579         2.36051142
  4        0.00565573          0.00213404         2.65024976
```

```
BACKYARD ONCE A WEEK COLLECTION   - COLL MINS PER SERVICE AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        42.37, VAR( 2)=         2.02, VAR( 3)=        24.10, VAR( 4)=         6.73,
VAR( 5)=         1.09

STANDARD DEVIATIONS
VAR( 1)=        10.89, VAR( 2)=         0.03, VAR( 3)=        20.60, VAR( 4)=         1.04,
VAR( 5)=         0.27

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=    -0.151, VARS( 1, 3)=     0.781, VARS( 1, 4)=    -0.072,
VARS( 1, 5)=     0.789
VARS( 2, 2)=     1.000, VARS( 2, 3)=    -0.243, VARS( 2, 4)=     0.059, VARS( 2, 5)=    -0.246
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.149, VARS( 3, 5)=     0.991
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.141

STEP NUMBER      1          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=              0.037
STD. DEV. AS PERCENT OF RESPONSE MEAN=        3.370
PERCENT VARIATION EXPLAINED R-SQ=            98.112
CORRECTED R-SQ AS A PERCENT=                 98.093
GOODNESS OF FIT OR OVERALL F,F(  1,100)=5195.563
CONSTANT TERM=                           0.78151322

VAR         COEFF              STD DEV            T VALUE
                                COEFF
  3         0.01278567         0.00017738       72.08027049

STEP NUMBER      2          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.036
STD. DEV. AS PERCENT OF RESPONSE MEAN=        3.330
PERCENT VARIATION EXPLAINED R-SQ=            98.175
CORRECTED R-SQ AS A PERCENT=                 98.138
GOODNESS OF FIT OR OVERALL F,F(  2, 99)=2662.688
CONSTANT TERM=                           0.74963952

VAR         COEFF              STD DEV            T VALUE
                                COEFF
  1         0.00098306         0.00053062        1.85268069
  3         0.01237985         0.00028053       44.13056097

STEP NUMBER      3          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              0.036
STD. DEV. AS PERCENT OF RESPONSE MEAN=        3.342
PERCENT VARIATION EXPLAINED R-SQ=            98.180
CORRECTED R-SQ AS A PERCENT=                 98.124
GOODNESS OF FIT OR OVERALL F,F(  3, 98)=1761.838
CONSTANT TERM=                           0.86334742

VAR         COEFF              STD DEV            T VALUE
                                COEFF
  1         0.00100025         0.00053371        1.87412005
```

(70)

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  2       -0.05640569           0.11186330        -0.50423761
  3        0.01235048           0.00028755        42.95050920

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=             0.037
STD. DEV. AS PERCENT OF RESPONSE MEAN=       3.357
PERCENT VARIATION EXPLAINED R-SQ=           98.182
CORRECTED R-SQ AS A PERCENT=                98.108
GOODNESS OF FIT OR OVERALL F,F(  4, 97)=1309.979
CONSTANT TERM=                          0.85597200

VAR         COEFF               STD DEV             T VALUE
                                 COEFF
  1        0.00098559           0.00053736         1.83414339
  2       -0.05725782           0.11237191        -0.50953854
  3        0.01236658           0.00029175        42.38797746
  4        0.00138513           0.00355602         0.38951628
```

APPENDIX 7

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CURB-ALLEY ONCE A WEEK COLLECTION - SERVICES PER COLL HRS AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        58.20, VAR( 2)=          2.01, VAR( 3)=        62.40, VAR( 4)=        8.92,
VAR( 5)=        91.81

STANDARD DEVIATIONS
VAR( 1)=        13.92, VAR( 2)=          0.85, VAR( 3)=        15.89, VAR( 4)=        3.09,
VAR( 5)=        28.68

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=    0.116, VARS( 1, 3)=    -0.228, VARS( 1, 4)=    -0.394,
VARS( 1, 5)=    -0.701
VARS( 2, 2)=     1.000, VARS( 2, 3)=    0.424, VARS( 2, 4)=    -0.112, VARS( 2, 5)=     0.040
VARS( 3, 3)=     1.000, VARS( 3, 4)=    0.644, VARS( 3, 5)=     0.613
VARS( 4, 4)=     1.000, VARS( 4, 5)=    0.697

STEP NUMBER      1          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              20.477
STD. DEV. AS PERCENT OF RESPONSE MEAN=        22.303
PERCENT VARIATION EXPLAINED R-SQ=             49.208
CORRECTED R-SQ AS A PERCENT=                  49.026
GOODNESS OF FIT OR OVERALL F,F(  1,279)=     270.301
CONSTANT TERM=                           175.94615337

VAR       COEFF              STD DEV            T VALUE
                              COEFF
 1     -1.44561770          0.08792857       -16.44081981

STEP NUMBER      2          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=              15.532
STD. DEV. AS PERCENT OF RESPONSE MEAN=        16.917
PERCENT VARIATION EXPLAINED R-SQ=             70.883
CORRECTED R-SQ AS A PERCENT=                  70.673
GOODNESS OF FIT OR OVERALL F,F(  2,278)=     338.381
CONSTANT TERM=                           108.99221751

VAR       COEFF              STD DEV            T VALUE
                              COEFF
 1     -1.22080319          0.06850063       -17.82176163
 3      0.86326676          0.06000969        14.38545606

STEP NUMBER      3          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              14.268
STD. DEV. AS PERCENT OF RESPONSE MEAN=        15.541
PERCENT VARIATION EXPLAINED R-SQ=             75.516
CORRECTED R-SQ AS A PERCENT=                  75.251
GOODNESS OF FIT OR OVERALL F,F(  3,277)=     284.787
CONSTANT TERM=                            94.62994430

VAR       COEFF              STD DEV            T VALUE
                              COEFF
 1     -1.06087974          0.06669170       -15.90722279
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  3        0.54828198          0.07022626          7.80736381
  4        2.76905211          0.38245525          7.24019904

STEP NUMBER      4          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              14.293
STD. DEV. AS PERCENT OF RESPONSE MEAN=        15.568
PERCENT VARIATION EXPLAINED R-SQ=             75.520
CORRECTED R-SQ AS A PERCENT=                  75.165
GOODNESS OF FIT OR OVERALL F,F(  4,276)= 212.860
CONSTANT TERM=                           94.48850183

VAR          COEFF              STD DEV            T VALUE
                                 COEFF
  1       -1.06186335         0.06698514       -15.85222208
  2        0.26863784         1.33153363         0.20175070
  3        0.53606740         0.09281333         5.77575861
  4        2.81610859         0.44853269         6.27849127

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CURB-ALLEY TWICE A WEEK COLLECTION- SERVICES PER COLL HRS AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        28.36, VAR( 2)=         2.02, VAR( 3)=        48.33, VAR( 4)=        14.89,
VAR( 5)=       139.07

STANDARD DEVIATIONS
VAR( 1)=         4.70, VAR( 2)=         0.82, VAR( 3)=         8.25, VAR( 4)=         4.44,
VAR( 5)=        46.99

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=      1.000, VARS( 1, 2)=     0.457, VARS( 1, 3)=     0.773, VARS( 1, 4)=    -0.643,
VARS( 1, 5)=      0.375
VARS( 2, 2)=      1.000, VARS( 2, 3)=     0.580, VARS( 2, 4)=    -0.292, VARS( 2, 5)=     0.967
VARS( 3, 3)=      1.000, VARS( 3, 4)=    -0.915, VARS( 3, 5)=     0.612
VARS( 4, 4)=      1.000, VARS( 4, 5)=    -0.361

STEP NUMBER      1            ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=           12.100
STD. DEV. AS PERCENT OF RESPONSE MEAN=      8.701
PERCENT VARIATION EXPLAINED R-SQ=          93.413
CORRECTED R-SQ AS A PERCENT=               93.370
GOODNESS OF FIT OR OVERALL F,F(  1,154)=2183.974
CONSTANT TERM=                        27.69260737

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  2       55.19388112         1.18104689       46.73301423

STEP NUMBER      2            ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=           11.500
STD. DEV. AS PERCENT OF RESPONSE MEAN=      8.269
PERCENT VARIATION EXPLAINED R-SQ=          94.089
CORRECTED R-SQ AS A PERCENT=               94.011
GOODNESS OF FIT OR OVERALL F,F(  2,153)=1217.624
CONSTANT TERM=                        44.12251156

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  2       53.75877734         1.17378807       45.79938994
  4       -0.90879463         0.21733462       -4.18154562

STEP NUMBER      3            ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=            8.872
STD. DEV. AS PERCENT OF RESPONSE MEAN=      6.379
PERCENT VARIATION EXPLAINED R-SQ=          96.505
CORRECTED R-SQ AS A PERCENT=               96.436
GOODNESS OF FIT OR OVERALL F,F(  3,152)=1399.016
CONSTANT TERM=                       117.86227458

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1       -2.18565931         0.21321045      -10.25118297
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   2       57.43045612           0.97377805        58.97694660
   4       -2.19582043           0.20945910       -10.48328952

STEP NUMBER     4          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            8.698
STD. DEV. AS PERCENT OF RESPONSE MEAN=      6.254
PERCENT VARIATION EXPLAINED R-SQ=          96.663
CORRECTED R-SQ AS A PERCENT=               96.575
GOODNESS OF FIT OR OVERALL F,F(  4,151)=1093.506
CONSTANT TERM=                        57.20122994

VAR         COEFF               STD DEV            T VALUE
                                 COEFF
  1       -2.55205410          0.24993054       -10.21105345
  2       54.13826117          1.55793436        34.75002697
  3        1.14192608          0.42704373         2.67402612
  4       -0.68481770          0.60122136        -1.13904421
```

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BACKYARD ONCE A WEEK COLLECTION   - SERVICES PER COLL HRS AS A FUNCTION OF LBS
PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        42.37, VAR( 2)=         2.02, VAR( 3)=        24.10, VAR( 4)=         6.73,
VAR( 5)=        58.47

STANDARD DEVIATIONS
VAR( 1)=        10.89, VAR( 2)=         0.03, VAR( 3)=        20.60, VAR( 4)=         1.04,
VAR( 5)=        14.11

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=    -0.151, VARS( 1, 3)=     0.781, VARS( 1, 4)=    -0.072,
VARS( 1, 5)=    -0.783
VARS( 2, 2)=     1.000, VARS( 2, 3)=    -0.243, VARS( 2, 4)=     0.059, VARS( 2, 5)=     0.254
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.149, VARS( 3, 5)=    -0.991
VARS( 4, 4)=     1.000, VARS( 4, 5)=     0.137

STEP NUMBER      1           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=             1.857
STD. DEV. AS PERCENT OF RESPONSE MEAN=      3.177
PERCENT VARIATION EXPLAINED R-SQ=          98.285
CORRECTED R-SQ AS A PERCENT=               98.268
GOODNESS OF FIT OR OVERALL F,F(  1,100)=5731.497
CONSTANT TERM=                        74.83873617

VAR        COEFF              STD DEV          T VALUE
                               COEFF
  3      -0.67931985        0.00697305      -75.70666049

STEP NUMBER      2           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=             1.856
STD. DEV. AS PERCENT OF RESPONSE MEAN=      3.174
PERCENT VARIATION EXPLAINED R-SQ=          98.305
CORRECTED R-SQ AS A PERCENT=               98.271
GOODNESS OF FIT OR OVERALL F,F(  2, 99)=2871.020
CONSTANT TERM=                        75.78810837

VAR        COEFF              STD DEV          T VALUE
                               COEFF
  1      -0.02928091        0.02714420       -1.07871701
  3      -0.66723252        0.01435070      -46.49478167

STEP NUMBER      3           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=             1.853
STD. DEV. AS PERCENT OF RESPONSE MEAN=      3.170
PERCENT VARIATION EXPLAINED R-SQ=          98.327
CORRECTED R-SQ AS A PERCENT=               98.276
GOODNESS OF FIT OR OVERALL F,F(  3, 98)=1919.690
CONSTANT TERM=                        62.84588680

VAR        COEFF              STD DEV          T VALUE
                               COEFF
  1      -0.03123679        0.02716246       -1.14999851
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  2       6.42008921          5.69308361        1.12769979
  3      -0.66388961          0.01463442      -45.36494221

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              1.857
STD. DEV. AS PERCENT OF RESPONSE MEAN=        3.176
PERCENT VARIATION EXPLAINED R-SQ=            98.338
CORRECTED R-SQ AS A PERCENT=                 98.269
GOODNESS OF FIT OR OVERALL F,F(  4, 97)=1434.604
CONSTANT TERM=                          63.61349291

VAR        COEFF              STD DEV             T VALUE
                               COEFF
  1      -0.02971170          0.02727974       -1.08914097
  2       6.50877587          5.70471814        1.14094609
  3      -0.66556539          0.01481097      -44.93732764
  4      -0.14415907          0.18052646       -0.79854814

                             RESIDUAL         NORMAL
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APPENDIX 8

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CURB ALLEY 1/WEEK - TONS/COLL HR AS A FUNCTION OF LBS/SERVICE/COLL, CREW SIZE,
% ONE-WAY ITEMS AND COLL MILES/DAY

AVERAGES
VAR( 1)=        58.20, VAR( 2)=         2.01, VAR( 3)=        62.40, VAR( 4)=         8.92,
VAR( 5)=         2.53

STANDARD DEVIATIONS
VAR( 1)=        13.92, VAR( 2)=         0.85, VAR( 3)=        15.89, VAR( 4)=         3.09,
VAR( 5)=         0.58

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=      1.000, VARS( 1, 2)=     0.116, VARS( 1, 3)=    -0.228, VARS( 1, 4)=    -0.394,
VARS( 1, 5)=      0.053
VARS( 2, 2)=      1.000, VARS( 2, 3)=     0.424, VARS( 2, 4)=    -0.112, VARS( 2, 5)=     0.278
VARS( 3, 3)=      1.000, VARS( 3, 4)=     0.644, VARS( 3, 5)=     0.657
VARS( 4, 4)=      1.000, VARS( 4, 5)=     0.624

STEP NUMBER      1          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            0.441
STD. DEV. AS PERCENT OF RESPONSE MEAN=     17.435
PERCENT VARIATION EXPLAINED R-SQ=          43.194
CORRECTED R-SQ AS A PERCENT=               42.990
GOODNESS OF FIT OR OVERALL F,F(  1,279)= 212.144
CONSTANT TERM=                         1.02275158

VAR        COEFF              STD DEV            T VALUE
                               COEFF
 3       0.02418938         0.00166075       14.56515524

STEP NUMBER      2          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=            0.415
STD. DEV. AS PERCENT OF RESPONSE MEAN=     16.374
PERCENT VARIATION EXPLAINED R-SQ=          50.078
CORRECTED R-SQ AS A PERCENT=               49.719
GOODNESS OF FIT OR OVERALL F,F(  2,278)= 139.437
CONSTANT TERM=                         0.95099683

VAR        COEFF              STD DEV            T VALUE
                               COEFF
 3       0.01605381         0.00203931        7.87217418
 4       0.06492906         0.01048622        6.19184413

STEP NUMBER      3          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=            0.373
STD. DEV. AS PERCENT OF RESPONSE MEAN=     14.712
PERCENT VARIATION EXPLAINED R-SQ=          59.842
CORRECTED R-SQ AS A PERCENT=               59.407
GOODNESS OF FIT OR OVERALL F,F(  3,277)= 137.593
CONSTANT TERM=                        -0.08888965

VAR        COEFF              STD DEV            T VALUE
                               COEFF
 1       0.01428983         0.00174126        8.20660058
```

```
  3        0.01550920           0.00183355          8.45858804
  4        0.09207006           0.00998557          9.22031458

STEP NUMBER      4          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            0.362
STD. DEV. AS PERCENT OF RESPONSE MEAN=     14.302
PERCENT VARIATION EXPLAINED R-SQ=          62.185
CORRECTED R-SQ AS A PERCENT=               61.636
GOODNESS OF FIT OR OVERALL F,F(  4,276)=  113.465
CONSTANT TERM=                        -0.16233753

VAR        COEFF                STD DEV              VALUE
                                 COEFF
  1        0.01377906           0.00169728          8.11833884
  2        0.13949756           0.03373854          4.13466542
  3        0.00916645           0.00235171          [illegible].89777376
  4        0.11650543           0.01136497         10.25127689
```

```
CURB ALLEY 2/WEEK - TONS/COLL HR AS A FUNCTION OF LBS/SERVICE/COLL, CREW SIZE,
% ONE-WAY ITEMS AND COLL MILES/DAY

AVERAGES
VAR( 1)=       28.36, VAR( 2)=        2.02, VAR( 3)=       48.33, VAR( 4)=       14.89,
VAR( 5)=        2.01

STANDARD DEVIATIONS
VAR( 1)=        4.70, VAR( 2)=        0.82, VAR( 3)=        8.25, VAR( 4)=        4.44,
VAR( 5)=        0.89

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.457, VARS( 1, 3)=     0.773, VARS( 1, 4)=    -0.643,
VARS( 1, 5)=     0.672
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.580, VARS( 2, 4)=    -0.292, VARS( 2, 5)=     0.939
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.915, VARS( 3, 5)=     0.796
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.554

STEP NUMBER     1          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=             0.308
STD. DEV. AS PERCENT OF RESPONSE MEAN=      15.312
PERCENT VARIATION EXPLAINED R-SQ=           88.150
CORRECTED R-SQ AS A PERCENT=                88.073
GOODNESS OF FIT OR OVERALL F,F(  1,154)=1145.584
CONSTANT TERM=                         -0.04164081

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  2       1.01831534        0.03008630       33.84647743

STEP NUMBER     2          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=             0.136
STD. DEV. AS PERCENT OF RESPONSE MEAN=       6.743
PERCENT VARIATION EXPLAINED R-SQ=           97.717
CORRECTED R-SQ AS A PERCENT=                97.687
GOODNESS OF FIT OR OVERALL F,F(  2,153)=3274.340
CONSTANT TERM=                         -1.54623438

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  2       0.77956672        0.01626154       47.93930023
  3       0.04109347        0.00162291       25.32085003

STEP NUMBER     3          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=             0.116
STD. DEV. AS PERCENT OF RESPONSE MEAN=       5.767
PERCENT VARIATION EXPLAINED R-SQ=           98.341
CORRECTED R-SQ AS A PERCENT=                98.308
GOODNESS OF FIT OR OVERALL F,F(  3,152)=3002.715
CONSTANT TERM=                         -1.71522860

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1       0.02367699        0.00313261        7.55823810
```

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```
  2        0.77772649          0.01391134          55.90595458
  3        0.03077466          0.00194701          15.80614956

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=                0.116
STD. DEV. AS PERCENT OF RESPONSE MEAN=          5.754
PERCENT VARIATION EXPLAINED R-SQ=              98.359
CORRECTED R-SQ AS A PERCENT=                   96.316
GOODNESS OF FIT OR OVERALL F,F(  4,151)=2263.236
CONSTANT TERM=                           -1.30263582

VAR        COEFF              STD DEV             T VALUE
                               COEFF
  1        0.02518176         0.00332833          7.56587518
  2        0.79799215         0.02074707         38.46289325
  3        0.02375095         0.00568696          4.17639046
  4       -0.01052116         0.00800649         -1.31407927
```

```
BACKYARD   1/WEEK - TONS/COLL HR AS A FUNCTION OF LBS/SERVICE/COLL, CREW SIZE,
% ONE-WAY ITEMS AND COLL MILES/DAY

AVERAGES
VAR( 1)=        42.37, VAR( 2)=         2.02, VAR( 3)=        24.10, VAR( 4)=         6.73,
VAR( 5)=         1.18

STANDARD DEVIATIONS
VAR( 1)=        10.89, VAR( 2)=         0.03, VAR( 3)=        20.60, VAR( 4)=         1.04,
VAR( 5)=         0.17

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=      1.000, VARS( 1, 2)=    -0.151, VARS( 1, 3)=     0.781, VARS( 1, 4)=    -0.072,
VARS( 1, 5)=      0.330
VARS( 2, 2)=      1.000, VARS( 2, 3)=    -0.243, VARS( 2, 4)=     0.059, VARS( 2, 5)=     0.138
VARS( 3, 3)=      1.000, VARS( 3, 4)=    -0.149, VARS( 3, 5)=    -0.308
VARS( 4, 4)=      1.000, VARS( 4, 5)=     0.091

STEP NUMBER      1           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=             0.157
STD. DEV. AS PERCENT OF RESPONSE MEAN=      13.324
PERCENT VARIATION EXPLAINED R-SQ=           10.869
CORRECTED R-SQ AS A PERCENT=                 9.978
GOODNESS OF FIT OR OVERALL F,F(  1,100)=    12.195
CONSTANT TERM=                           0.96669984

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1        0.00501296         0.00143552         3.49208065

STEP NUMBER      2           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=             0.045
STD. DEV. AS PERCENT OF RESPONSE MEAN=       3.841
PERCENT VARIATION EXPLAINED R-SQ=           92.666
CORRECTED R-SQ AS A PERCENT=                92.517
GOODNESS OF FIT OR OVERALL F,F(  2, 99)=   625.403
CONSTANT TERM=                           0.51890594

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1        0.02219998         0.00066244        33.51233847
  3       -0.01163715         0.00035022       -33.22790539

STEP NUMBER      3           ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=             0.045
STD. DEV. AS PERCENT OF RESPONSE MEAN=       3.851
PERCENT VARIATION EXPLAINED R-SQ=           92.702
CORRECTED R-SQ AS A PERCENT=                92.478
GOODNESS OF FIT OR OVERALL F,F(  3, 98)=   414.938
CONSTANT TERM=                           0.53913142

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1        0.02223315         0.00066586        33.38998820
```

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  3       -0.01167395          0.00035507       -32.87792586
  4       -0.00308085          0.00441416        -0.69794788

STEP NUMBER     4          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            0.046
STD. DEV. AS PERCENT OF RESPONSE MEAN=      3.870
PERCENT VARIATION EXPLAINED R-SQ=          92.707
CORRECTED R-SQ AS A PERCENT=               92.406
GOODNESS OF FIT OR OVERALL F,F(  4, 97)=  308.271
CONSTANT TERM=                          0.46399175

VAR        COEFF               STD DEV             T VALUE
                                COEFF
  1        0.02222202          0.00067034        33.15014651
  2        0.03734855          0.14018193         0.26642911
  3       -0.01165478          0.00036395       -32.02306013
  4       -0.00310366          0.00443607        -0.69968703
```

APPENDIX 9

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CURB-ALLEY ONCE A WEEK COLLECTION - COST PER SERVICE PER WEEK AS A FUNCTION OF
LBS PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        58.20, VAR( 2)=         2.01, VAR( 3)=        62.40, VAR( 4)=         8.92,
VAR( 5)=         0.33

STANDARD DEVIATIONS
VAR( 1)=        13.92, VAR( 2)=         0.85, VAR( 3)=        15.89, VAR( 4)=         3.09,
VAR( 5)=         0.13

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.116, VARS( 1, 3)=    -0.228, VARS( 1, 4)=    -0.394,
VARS( 1, 5)=     0.463
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.424, VARS( 2, 4)=    -0.112, VARS( 2, 5)=     0.765
VARS( 3, 3)=     1.000, VARS( 3, 4)=     0.644, VARS( 3, 5)=    -0.162
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.636

STEP NUMBER      1          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=              0.081
STD. DEV. AS PERCENT OF RESPONSE MEAN=     24.550
PERCENT VARIATION EXPLAINED R-SQ=          58.478
CORRECTED R-SQ AS A PERCENT=               58.330
GOODNESS OF FIT OR OVERALL F,F(  1,279)= 392.939
CONSTANT TERM=                         0.10356716

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  2       0.11220848         0.00566061        19.82269266

STEP NUMBER      2          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=              0.042
STD. DEV. AS PERCENT OF RESPONSE MEAN=     12.603
PERCENT VARIATION EXPLAINED R-SQ=          89.103
CORRECTED R-SQ AS A PERCENT=               89.025
GOODNESS OF FIT OR OVERALL F,F(  2,278)=1136.584
CONSTANT TERM=                         0.32369137

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  2       0.10303979         0.00292354        35.24484728
  4      -0.02259807         0.00080847       -27.95151055

STEP NUMBER      3          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.035
STD. DEV. AS PERCENT OF RESPONSE MEAN=     10.660
PERCENT VARIATION EXPLAINED R-SQ=          92.233
CORRECTED R-SQ AS A PERCENT=               92.149
GOODNESS OF FIT OR OVERALL F,F(  3,277)=1096.493
CONSTANT TERM=                         0.19968888

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1       0.00173905         0.00016459        10.56588300
  2       0.10097655          0.00248033         40.71095110
  4      -0.01957865          0.00074109        -26.41861118

STEP NUMBER     4          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=           0.028
STD. DEV. AS PERCENT OF RESPONSE MEAN=     8.438
PERCENT VARIATION EXPLAINED R-SQ=         95.151
CORRECTED R-SQ AS A PERCENT=              95.080
GOODNESS OF FIT OR OVERALL F,F(  4,276)=1353.909
CONSTANT TERM=                        0.22871936

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1       0.00170526          0.00013031         13.08571191
  2       0.12275106          0.00259041         47.38679281
  3      -0.00232677          0.00018056        -12.88627539
  4      -0.01125465          0.00087259        -12.89799614
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CURB-ALLEY TWICE A WEEK COLLECTION- COST PER SERVICE PER WEEK AS A FUNCTION OF
LBS PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        28.36, VAR( 2)=         2.02, VAR( 3)=        48.33, VAR( 4)=        14.89,
VAR( 5)=         0.46

STANDARD DEVIATIONS
VAR( 1)=         4.70, VAR( 2)=         0.82, VAR( 3)=         8.25, VAR( 4)=         4.44,
VAR( 5)=         0.06

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.457, VARS( 1, 3)=     0.773, VARS( 1, 4)=    -0.643,
VARS( 1, 5)=    -0.090
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.580, VARS( 2, 4)=    -0.292, VARS( 2, 5)=     0.723
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.915, VARS( 3, 5)=    -0.125
VARS( 4, 4)=     1.000, VARS( 4, 5)=     0.386

STEP NUMBER     1          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=             0.039
STD. UEV. AS PERCENT UF RESPONSE MEAN=       8.515
PERCENT VARIATION EXPLAINED R-SQ=           52.303
CORRECTED R-SQ AS A PERCENT=                51.994
GOODNESS OF FIT OR OVERALL F,F(  1,154)= 168.874
CONSTANT TERM=                          0.35983642

VAR        COEFF             STD DEV          T VALUE
                              COEFF
  2        0.04969232        0.00382391       12.99514287

STEP NUMBER     2          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=             0.010
STD. DEV. AS PERCENT OF RESPONSE MEAN=       2.162
PERCENT VARIATIUN EXPLAINED R-SQ=           96.946
CORRECTED R-SQ AS A PERCENT=                96.906
GOODNESS OF FIT OR OVERALL F,F(  2,153)=2428.227
CONSTANT TERM=                          0.56571093

VAR        COEFF             STD DEV          T VALUE
                              COEFF
  2        0.08236479        0.00119155       69.12415196
  3       -0.00562359        0.00011892      -47.28998829

STEP NUMBER     3          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=             0.010
STD. DEV. AS PERCENT OF RESPONSE MEAN=       2.083
PERCENT VARIATION EXPLAINED R-SQ=           97.184
CORRECTED R-SQ AS A PERCENT=                97.128
GOODNESS OF FIT OR OVERALL F,F(  3,152)=1740.205
CONSTANT TERM=                          0.65535518

VAR        COEFF             STD DEV          T VALUE
                              COEFF
  2        0.08668098        0.00166423       52.08473778
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   3      -0.00697205          0.00039348        -17.71881700
   4      -0.00222794          0.00062195         -3.58218822

STEP NUMBER     4           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=              0.010
STD. DEV. AS PERCENT OF RESPONSE MEAN=        2.085
PERCENT VARIATION EXPLAINED R-SQ=            97.196
CORRECTED R-SQ AS A PERCENT=                 97.122
GOODNESS OF FIT OR OVERALL F,F(  4,151)=1308.466
CONSTANT TERM=                           0.60122435

VAR         COEFF               STD DEV             T VALUE
                                 COEFF
  1       0.00022433          0.00027566          0.81377551
  2       0.08702322          0.00171834         50.64367743
  3      -0.00718219          0.00047101        -15.24837727
  4      -0.00241360          0.00066312         -3.63974120
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BACKYARD ONCE A WEEK COLLECTION   - COST PER SERVICE PER WEEK AS A FUNCTION OF
LBS PER SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        42.37, VAR( 2)=          2.02, VAR( 3)=        24.10, VAR( 4)=         6.73,
VAR( 5)=         0.40

STANDARD DEVIATIONS
VAR( 1)=        10.89, VAR( 2)=          0.03, VAR( 3)=        20.60, VAR( 4)=         1.04,
VAR( 5)=         0.07

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=    -0.151, VARS( 1, 3)=     0.781, VARS( 1, 4)=    -0.072,
VARS( 1, 5)=     0.791
VARS( 2, 2)=     1.000, VARS( 2, 3)=    -0.243, VARS( 2, 4)=     0.059, VARS( 2, 5)=    -0.164
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.149, VARS( 3, 5)=     0.990
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.127

STEP NUMBER      1           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=             0.010
STD. DEV. AS PERCENT OF RESPONSE MEAN=       2.560
PERCENT VARIATION EXPLAINED R-SQ=           98.025
CORRECTED R-SQ AS A PERCENT=                98.005
GOODNESS OF FIT OR OVERALL F,F(  1,100)=4963.551
CONSTANT TERM=                          0.31326981

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  3        0.00345575        0.00004905       70.45248592

STEP NUMBER      2           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=             0.008
STD. DEV. AS PERCENT OF RESPONSE MEAN=       2.129
PERCENT VARIATION EXPLAINED R-SQ=           98.648
CORRECTED R-SQ AS A PERCENT=                98.620
GOODNESS OF FIT OR OVERALL F,F(  2, 99)=3610.928
CONSTANT TERM=                         -0.04075887

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  2        0.17476236        0.02588590        6.75125706
  3        0.00352477        0.00004206       83.81300516

STEP NUMBER      3           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=             0.008
STD. DEV. AS PERCENT OF RESPONSE MEAN=       2.092
PERCENT VARIATION EXPLAINED R-SQ=           98.708
CORRECTED R-SQ AS A PERCENT=                98.668
GOODNESS OF FIT OR OVERALL F,F(  3, 98)=2495.080
CONSTANT TERM=                         -0.04213635

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1        0.00025933        0.00012160        2.13265027
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  2        0.17129177          0.02540614        6.72097885
  3        0.00341635          0.00006551       52.14712223

STEP NUMBER     4         ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=           0.008
STD. DEV. AS PERCENT OF RESPONSE MEAN=     2.079
PERCENT VARIATION EXPLAINED R-SQ=         98.737
CORRECTED R-SQ AS A PERCENT=              98.685
GOODNESS OF FIT OR OVERALL F,F(  4, 97)=1895.211
CONSTANT TERM=                       -0.04850034

VAR        COEFF              STD DEV             T VALUE
                               COEFF
  1        0.00024668          0.00012114        2.03627489
  2        0.17055650          0.02533343        6.73246781
  3        0.00343024          0.00006577       52.15327272
  4        0.00119518          0.00080168        1.49084513
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APPENDIX 10

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CURB-ALLEY ONCE A WEEK COLLECTION - CUST PER TON AS A FUNCTION OF LBS PER
SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        58.20, VAR( 2)=         2.01, VAR( 3)=        62.40, VAR( 4)=         8.92,
VAR( 5)=        11.45

STANDARD DEVIATIONS
VAR( 1)=        13.92, VAR( 2)=         0.85, VAR( 3)=        15.89, VAR( 4)=         3.09,
VAR( 5)=         3.87

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=     0.116, VARS( 1, 3)=    -0.228, VARS( 1, 4)=    -0.394,
VARS( 1, 5)=    -0.137
VARS( 2, 2)=     1.000, VARS( 2, 3)=     0.424, VARS( 2, 4)=    -0.112, VARS( 2, 5)=     0.756
VARS( 3, 3)=     1.000, VARS( 3, 4)=     0.644, VARS( 3, 5)=    -0.032
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.459

STEP NUMBER     1           ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            2.541
STD. DEV. AS PERCENT OF RESPONSE MEAN=     22.189
PERCENT VARIATION EXPLAINED R-SQ=          57.103
CORRECTED R-SQ AS A PERCENT=               56.949
GOODNESS OF FIT OR OVERALL F,F(  1,279)= 371.395
CONSTANT TERM=                         4.55341316

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  2       3.42477931       0.17771115       19.27160640

STEP NUMBER     2           ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            2.049
STD. DEV. AS PERCENT OF RESPONSE MEAN=     17.893
PERCENT VARIATION EXPLAINED R-SQ=          72.205
CORRECTED R-SU AS A PERCENT=               72.005
GOODNESS OF FIT OR OVERALL F,F(  2,278)= 361.087
CONSTANT TERM=                         9.41966510

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  2       4.24873775       0.15821336       26.85448136
  3      -0.10457238       0.00850872      -12.29002163

STEP NUMBER     3           ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=            1.487
STD. DEV. AS PERCENT OF RESPONSE MEAN=     12.985
PERCENT VARIATION EXPLAINED R-SQ=          85.414
CORRECTED R-SQ AS A PERCENT=               85.256
GOODNESS OF FIT OR OVERALL F,F(  3,277)= 540.680
CONSTANT TERM=                        16.71538522

VAR        COEFF             STD DEV           T VALUE
                              COEFF
  1      -0.10701829       0.00675707      -15.83797140
  2       4.70080010          0.11831360       39.73169655
  3      -0.13626359          0.00649108      -20.99243048

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=            1.227
STD. DEV. AS PERCENT OF RESPONSE MEAN=     10.720
PERCENT VARIATION EXPLAINED R-SQ=          90.096
CORRECTED R-SQ AS A PERCENT=               89.952
GOODNESS OF FIT OR OVERALL F,F(  4,276)= 627.657
CONSTANT TERM=                         18.73787446

VAR         COEFF               STD DEV           T VALUE
                                 COEFF
  1      -0.12307001          0.00575239      -21.39457723
  2       4.02162393          0.11434632       35.17055910
  3      -0.06886902          0.00797041       -8.64059134
  4      -0.43996094          0.03851804      -11.42220575
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CURB-ALLEY TWICE A WEEK COLLECTION- COST PER TON AS A FUNCTION OF LBS PER
SERVICE PER COLL, CREW SIZE, & ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=         28.36, VAR( 2)=         2.02, VAR( 3)=        48.33, VAR( 4)=        14.89,
VAR( 5)=         16.72

STANDARD DEVIATIONS
VAR( 1)=          4.70, VAR( 2)=         0.82, VAR( 3)=         8.25, VAR( 4)=         4.44,
VAR( 5)=          3.85

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=      1.000, VARS( 1, 2)=     0.457, VARS( 1, 3)=     0.773, VARS( 1, 4)=    -0.643,
VARS( 1, 5)=     -0.788
VARS( 2, 2)=      1.000, VARS( 2, 3)=     0.580, VARS( 2, 4)=    -0.292, VARS( 2, 5)=     0.074
VARS( 3, 3)=      1.000, VARS( 3, 4)=    -0.915, VARS( 3, 5)=    -0.658
VARS( 4, 4)=      1.000, VARS( 4, 5)=     0.709

STEP NUMBER      1          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=            2.381
STD. DEV. AS PERCENT OF RESPONSE MEAN=     14.236
PERCENT VARIATION EXPLAINED R-SQ=          62.071
CORRECTED R-SQ AS A PERCENT=               61.824
GOODNESS OF FIT OR OVERALL F,F(  1,154)= 252.019
CONSTANT TERM=                        35.06000146

VAR         COEFF               STD DEV            T VALUE
                                 COEFF
 1       -0.64656518          0.04072827      -15.87509676

STEP NUMBER      2          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=            1.453
STD. DEV. AS PERCENT OF RESPONSE MEAN=      8.687
PERCENT VARIATION EXPLAINED R-SQ=          85.969
CORRECTED R-SQ AS A PERCENT=               85.786
GOODNESS OF FIT OR OVERALL F,F(  2,153)= 468.722
CONSTANT TERM=                        35.71727502

VAR         COEFF               STD DEV            T VALUE
                                 COEFF
 1       -0.85291693          0.02794703      -30.51905846
 2        2.57415745          0.15945929       16.14303871

STEP NUMBER      3          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=            0.882
STD. DEV. AS PERCENT OF RESPONSE MEAN=      5.275
PERCENT VARIATION EXPLAINED R-SQ=          94.860
CORRECTED R-SQ AS A PERCENT=               94.758
GOODNESS OF FIT OR OVERALL F,F(  3,152)= 935.051
CONSTANT TERM=                        38.24966175

VAR         COEFF               STD DEV            T VALUE
                                 COEFF
 1       -0.58228192          0.02380304      -24.46250407
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  2       3.26157036          0.10570494        30.85542147
  3      -0.23988515          0.01479427       -16.21473094

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=             0.861
STD. DEV. AS PERCENT OF RESPONSE MEAN=       5.150
PERCENT VARIATION EXPLAINED R-SQ=           95.132
CORRECTED R-SQ AS A PERCENT=                95.003
GOODNESS OF FIT OR OVERALL F,F(  4,151)= 737.738
CONSTANT TERM=                          45.03427576

VAR        COEFF              STD DEV            T VALUE
                               COEFF
  1      -0.55753779          0.02475189       -22.52505523
  2       3.59481584          0.15429018        23.29905834
  3      -0.35538200          0.04229232        -8.40299219
  4      -0.17300833          0.05954201        -2.90565122
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BACKYARD ONCE A WEEK COLLECTION   - COST PER TON AS A FUNCTION OF LBS PER
SERVICE PER COLL, CREW SIZE, % ONE-WAY ITEMS, AND COLL MILES PER DAY

AVERAGES
VAR( 1)=        42.37, VAR( 2)=         2.02, VAR( 3)=        24.10, VAR( 4)=         6.73,
VAR( 5)=        19.15

STANDARD DEVIATIONS
VAR( 1)=        10.89, VAR( 2)=         0.03, VAR( 3)=        20.60, VAR( 4)=         1.04,
VAR( 5)=         2.63

SIMPLE CORRELATION COEFFICIENTS
VARS( 1, 1)=     1.000, VARS( 1, 2)=    -0.151, VARS( 1, 3)=     0.781, VARS( 1, 4)=    -0.072,
VARS( 1, 5)=    -0.639
VARS( 2, 2)=     1.000, VARS( 2, 3)=    -0.243, VARS( 2, 4)=     0.059, VARS( 2, 5)=     0.073
VARS( 3, 3)=     1.000, VARS( 3, 4)=    -0.149, VARS( 3, 5)=    -0.050
VARS( 4, 4)=     1.000, VARS( 4, 5)=    -0.029

STEP NUMBER      1          ENTER VARIABLE  1
STANDARD DEVIATION OF RESIDUALS=               2.035
STD. DEV. AS PERCENT OF RESPONSE MEAN=        10.627
PERCENT VARIATION EXPLAINED R-SQ=             40.769
CORRECTED R-SQ AS A PERCENT=                  40.177
GOODNESS OF FIT OR OVERALL F,F(  1,100)=      68.830
CONSTANT TERM=                           25.68094281

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1      -0.15424667        0.01859200       -8.29640956

STEP NUMBER      2          ENTER VARIABLE  3
STANDARD DEVIATION OF RESIDUALS=               0.731
STD. DEV. AS PERCENT OF RESPONSE MEAN=         3.819
PERCENT VARIATION EXPLAINED R-SQ=             92.429
CORRECTED R-SQ AS A PERCENT=                  92.276
GOODNESS OF FIT OR OVERALL F,F(  2, 99)=     604.277
CONSTANT TERM=                           31.33476683

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1      -0.37124920        0.01069324      -34.71813321
  3       0.14693015        0.00565334       25.98997190

STEP NUMBER      3          ENTER VARIABLE  2
STANDARD DEVIATION OF RESIDUALS=               0.655
STD. DEV. AS PERCENT OF RESPONSE MEAN=         3.421
PERCENT VARIATION EXPLAINED R-SQ=             93.984
CORRECTED R-SQ AS A PERCENT=                  93.800
GOODNESS OF FIT OR OVERALL F,F(  3, 98)=     510.363
CONSTANT TERM=                           10.91538628

VAR        COEFF              STD DEV           T VALUE
                               COEFF
  1      -0.37433505        0.00959962      -38.99478968
  2       10.12919181           2.01202057           5.03433809
  3        0.15220436           0.00517202          29.42840507

STEP NUMBER     4          ENTER VARIABLE  4
STANDARD DEVIATION OF RESIDUALS=             0.654
STD. DEV. AS PERCENT OF RESPONSE MEAN=       3.414
PERCENT VARIATION EXPLAINED R-SQ=           94.070
CORRECTED R-SQ AS A PERCENT=                93.825
GOODNESS OF FIT OR OVERALL F,F(  4, 97)= 384.664
CONSTANT TERM=                          10.51566350

VAR        COEFF                STD DEV             T VALUE
                                 COEFF
  1       -0.37512922           0.00960388         -39.06015421
  2       10.08300917           2.00835675           5.02052693
  3        0.15307700           0.00521423          29.35754891
  4        0.07506931           0.06355468           1.18117680
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